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THE WOLF SPIDERS OF ARTESIAN SPRINGS IN ARID SOUTH AUSTRALIA, WITH A REVALIDATION OF *TETRALYCOSA* (ARANEAE, LYCOSIDAE)

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ABSTRACT. Artesian springs, commonly referred to as mound springs, are isolated unique threatened wetlands in arid central Australia that harbor a large number of endemic and relict species. Wolf spiders (Lycosidae) are the dominant invertebrate predators in mound springs and are the most abundant spider family present. Nine species are common, five of which are known to occur in other Australian wetland habitats, such as river floodplains and lakeshores: *Artoria howquaensis* Framenau 2002, *Hogna crispipes* (L. Koch 1877) new combination (= *Trochosa pulveresparsa* (L. Koch 1877) new synonymy; = *Geolycosa tongatabuensis* (Strand 1911) new synonymy; = *Tarentula tanna* Strand 1913 new synonymy; = *Lycosa waitei* Rainbow 1917 new synonymy; = *Lycosa strenua* Rainbow 1920 new synonymy; = *Lycosa rainbowi* (Roewer 1951) new synonymy), *Venatrix arenaris* (Hogg 1905), *V. fontis* Framenau & Vink 2001, and *V. goyderi* (Hickman 1944). Four species commonly found in mound springs are described as new: *Artoria victoriensis* new species, *Hogna diyari* new species, *H. kuyani* new species, and *Tetralycosa arabanae* new species. *Venatrix fontis* and *T. arabanae* are mainly found at mound springs and have only rarely been recorded from other wetland habitats. *Tetralycosa* Roewer 1960 is revalidated with *Lycosa meracula* Simon 1909 as type species. The genus is defined by its unique male pedipalp morphology with a deeply divided tegulum that carries a mesally directed spur on its retrolateral section opposing the hook-shaped median apophysis. Three Australian species are transferred to *Tetralycosa*: *T. alteripa* (McKay 1976) new combination, *T. eyrei* (Hickman 1944) new combination and *T. oraria* (L. Koch 1876) new combination (= *Trochosa candicans* (L. Koch 1877) new synonymy; = *Lycosa meracula* Simon 1909 new synonymy). *Hogna pexa* (Hickman 1944) new combination, an Australian wolf spider closely related to *Hogna kuyani* new species, is transferred from *Pardosa*.

Keywords: *Artoria*, *Venatrix*, *Hogna*, systematics, new species, mound springs

Central Australia is one of the driest places on earth. In the northern regions of South Australia the mean annual rainfall is between 100–150 mm and has an annual evaporation rate in excess of 3600 mm (Kotwicki 1987). The largest single source of water in this region is located below the surface in an enormous aquifer known as the Great Artesian Basin. This basin is a single continuous aquifer spanning 1.76 million km^2 across the states of Queensland, New South Wales, South Australia and the Northern Territory (Habermehl 1980, 1982; Harris 1992). The water from this basin discharges naturally from artesian springs (referred to as mound springs in South Australia) and artificially from free flowing bores (known locally as bore drains) (Fig. 1). These springs and bores form habitats that are analogous to islands in an otherwise desert environment for species that are dependent on permanent water for their survival (Harris 1981).

Artesian springs in this region form at fractures and fault lines along the margin of the basin creating wetlands of varying sizes. The typical artesian spring in South Australia is a low mound with water flowing from the top and forming a wetland around the base (Fig. 2). The mound is formed as water with high mineral and bicarbonate content precipitates minerals on the surface that over time create a raised area. Additionally, vegetation around

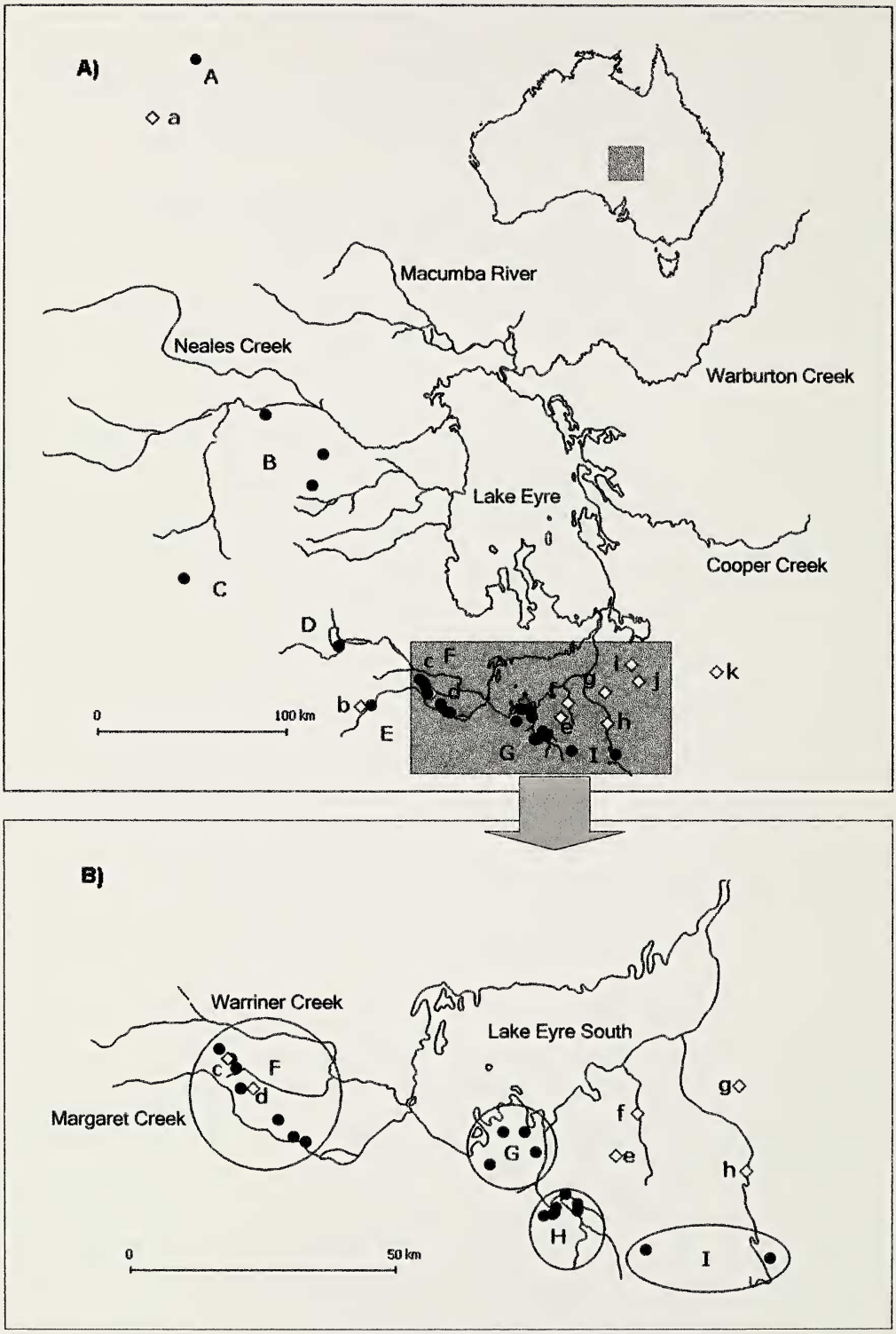

Figure 1.—Geographical locations of the South Australian artesian springs and bore drains. (A) shows the distribution of artesian spring complexes (●, capital letters) and flowing bore brains (◊, lower case letters) included in this study; (B) is an expanded view of the spring complexes and bore drains around Lake Eyre South. Artesian spring complexes: A = Dalhousie, B = Neales River, C = Lake Cadibarrawirracanna, D = Francis Swamp, E = Billa Kalina, F = Margaret River, G = Lake Eyre South, H =

the discharge region traps and collects windblown sand (Habermehl 1982). The flow rate from these artesian springs ranges from almost insignificant for small soaks to greater than 50 million litres per day such as at Dalhousie Springs (Sibenaler 1996). The wetland area is dependent on water flow and is categorized into two areas. The vent is the area where water issues from the ground and can vary in form from an active spring with a pool of open water to a damp soak, and there can be one to a number of vents associated with a particular mound. The tail is the part of the spring that results from the outflow of water away from the vent. It can be a channel or a uniform flow radiating out from the vent, and can range in area from less than 1 m^2 to greater than 70 ha and over 16 km in length (Sibenaler 1996). These areas support substantial water dependent vegetation that is usually dominated by only one or two species (Symon 1985; Fatchen & Fatchen 1993).

Artesian springs in South Australia host numerous endemic species of high conservation status due to their very restricted distribution and potential threats to the integrity of their fragile habitats. They include endemic gastropods, crustaceans and fish (Ferguson 1985; Ponder 1985; Boyd 1990; Kinhill Engineers 1997). Artesian springs are threatened by a number of human impacts, most importantly excessive water consumption by cattle, mining companies and gas abstraction operations. This may result in a localized reduction of water pressure in the Great Artesian Basin followed by reduced flows and, in rare instances, spring extinction (Kinhill Engineers 1997).

Recent studies of artesian springs and bore drains in South Australia have shown that wolf spiders (Lycosidae) are the most abundant predatory group. They include a number of undescribed taxa and are associated with vegetated areas of *Cyperus laevigatus*, *Phragmites australis* and *Typha domingensis* both at the vent and on the tail (Lamb 1998; Gotch 2000). Other spider families have been reported from artesian springs and bore drains in lower numbers, including Hahniidae, Pisauridae, Linyphiidae, Clubionidae, Salticidae, Zodariidae, Oxyopidae, Gnaphosidae, Desidae, Corinnidae, Araneidae, Tetragnathidae and Prodidomidae (Lamb 1998; Gotch 2000; D. Niejalke & D. Hirst, pers. comm.).

Here we provide a complete taxonomic treatment of wolf spiders of artesian springs in South Australia to facilitate their identification as part of on-going research to develop procedures for environmental monitoring of these unique habitats.

METHODS

Typical artesian spring lycosids as defined for this study are species which are facultatively dependent on the occurrence of open spring or bore water and will only be found in the confined space where it is available. These do not include the mostly burrowing species of the arid environment surrounding the springs, which on rare occasions can be found at the springs (for example *Lycosa woonda* McKay 1979; VWF, TBG pers. obs.).

This study is mainly based on material collected during three studies on the arthropod communities of South Australian artesian springs (Lamb 1998; Gotch 2000) lodged at the South Australian Museum. In addition, the collections of all other major museums in Australia were examined thoroughly for conspecifics of the artesian spring species as part of an ongoing revision of the Lycosidae of Australia.

Descriptions are based on specimens preserved in 70% EtOH. Internal female genitalia were prepared for examination by submersion in 10% KOH overnight at room temperature. For clarity, the illustrations of epigyna and male pedipalps omit the setae. The morphological nomenclature follows Framenau & Vink (2001) and Framenau (2002). All type material was examined unless otherwise stated. All measurements are in millimeters (mm).

Abbreviations.—*Eyes:* anterior (AE), anterior median (AME), anterior lateral (ALE), posterior (PE), posterior median (PME), posterior lateral (PLE). *Measurements (adult spiders, if not otherwise stated):* total length

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Hermit Hill, I = Davenport/Wangianna. Bore drains: a = Hamilton, b = Welcome, c = Elizabeth, d = Coward, e = Charles Angus, f = Morris Creek, g = Crows Nest, h = Coranna, i = Muloorina, j = Lake Letty no. 3, k = Clayton.

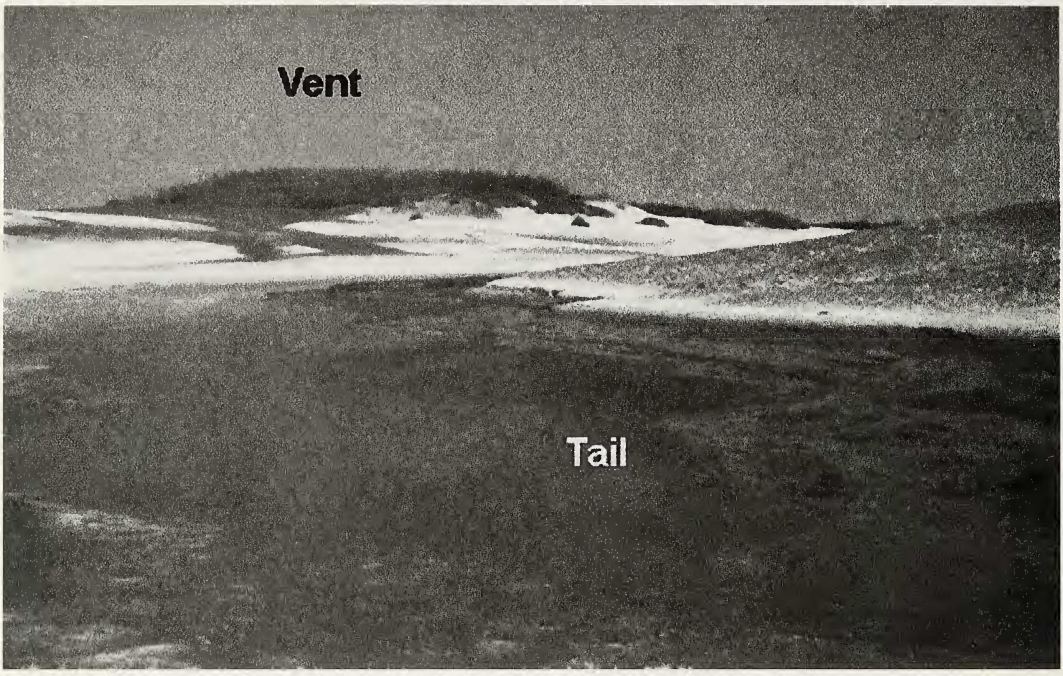


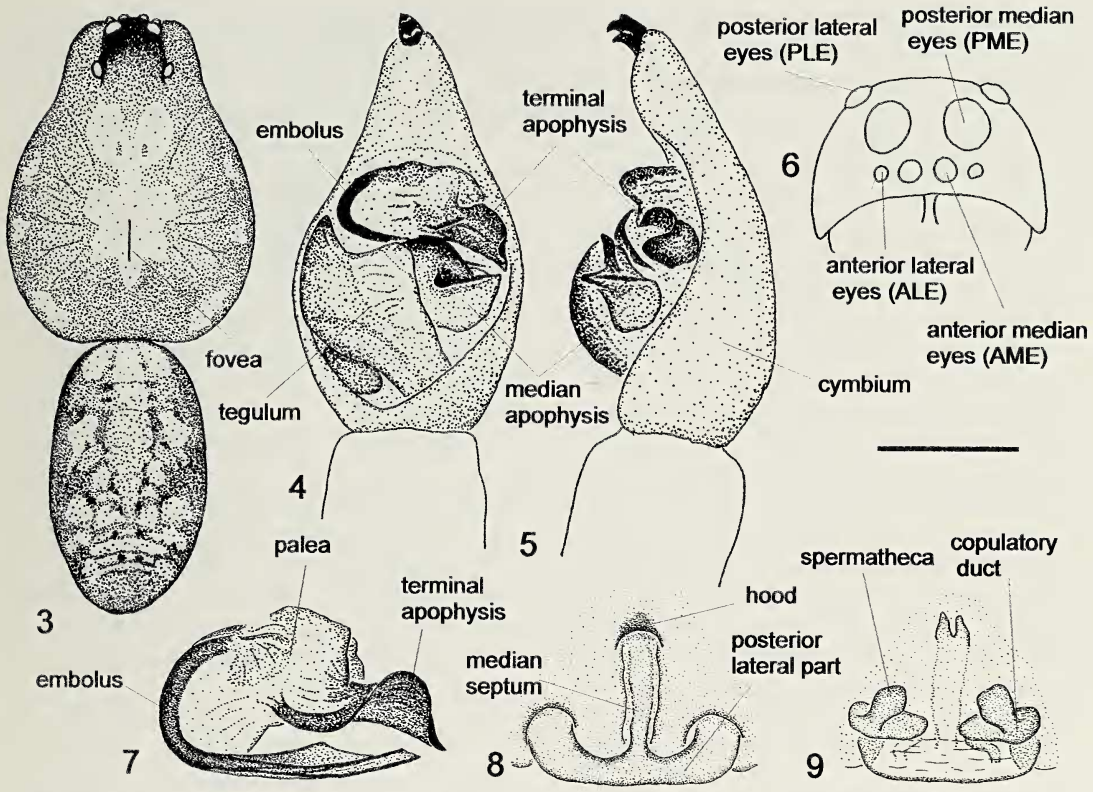
Figure 2.—McLachlan Springs, a typical artesian spring in South Australia showing the vent and tail microhabitats.

(TL), carapace length (CL) and width (CW), abdomen length (AL) and width (AW). *Australian States and Territories*: Australian Capital Territory (ACT), New South Wales (NSW), Northern Territory (NT), Queensland (Qld), South Australia (SA), Tasmania (Tas), Victoria (Vic), Western Australia (WA).

Collections: AM = Australian Museum, Sydney; ANIC = Australian National Insect Collection, Canberra; BMNH = Natural History Museum, London; CVIC = Central Victorian Insect Collection, LaTrobe University, Bendigo; MNHP = Museum National d'Histoire Naturelle, Paris; MV = Museum Victoria, Melbourne; QM = Queensland Museum, Brisbane; QVMAG = Queen Victoria Museum and Art Gallery, Launceston; SAM = South Australian Museum, Adelaide; SMF = Senckenberg Museum, Frankfurt; TMAG = Tasmanian Museum and Art Gallery, Hobart; WAM = Western Australian Museum, Perth; ZMB = Museum für Naturkunde, Zentralinstitut der Humboldt-Universität, Berlin; ZMH = Zoologisches Institut und Zoologisches Museum, Universität Hamburg.

KEY TO LYCOSIDAE OF SOUTH AUSTRALIAN ARTESIAN SPRINGS

1. Male pedipalp with basoembolic apophysis that reaches around the base of the median apophysis; median apophysis with a long narrow base, originating apically at tegulum (Figs. 59, 65, 67); epigynum a simple posterior atrium that is sclerotized laterally (Fig. 61), or with a posterior sclerotized rim that reaches anteriorly into a white, oval center (Fig. 68) Genus *Artoria* Thorell 1877 8
   Male pedipalp without basoembolic apophysis, median apophysis originating laterally at tegulum (Figs. 4, 11, 15, 20, 35, 42), or a basally directed broad hook (Fig. 49); epigynum inverted T-shaped (Figs. 8, 13, 25, 27–31, 38, 45), or a triangular atrium (Figs. 17, 54, 55) 2
2. Tegulum of male pedipalp with deep and wide longitudinal division in retrolateral half, median apophysis forms a basally directed hook opposing a distinct tip on the retrolateral part of the tegulum (Fig. 49); female epigynum forms a triangular atrium, hoods clearly



Figures 3–9.—*Venatrix arenaris* (Hogg 1905): Male from Horse Springs, SA (WAM T47290): 3. habitus; 4. left pedipalp, ventral; 5. left pedipalp, retrolateral; 6. eye arrangement; 7. apical part of bulb. Female from Fred Springs, SA (WAM T47292): 8. ventral view of epigynum; 9. dorsal view of epigynum. Scale bar: (3) 2.07 mm, (4, 5) 0.58 mm, (6) 0.98 mm, (7) 0.36 mm, (8, 9) 0.46 mm.

separated (Figs. 54, 55); carapace and abdomen light yellowish-brown, carapace with indistinct dark radial pattern, abdomen with indistinct white patches (Fig. 48); small spiders; TL 4.8–11.5 mm. Main distribution at artesian springs, occasionally near salt lakes (only recorded from SA) ..... ***Tetralycosa arabanae*** new species

Tegulum not divided, median apophysis directed retrolaterally, much broader at the base than tip and with a ventrally directed process (e. g. Figs. 4, 11, 15, 20, 35, 42); epigynum inverted T-shaped (e. g. Figs. 8, 13, 25, 27–31, 38, 45), or a triangular atrium with distinct anterior hoods separated from atrium (Fig. 17); carapace brown with light median band or uniformly dark grey to black; small to medium-sized spiders; TL 5.5–20.0 Subfamily Lycosinae 3

3. Tip of male cymbium with large, claw-like setae (Figs. 4–5, 11, 15), outer edge of fangs in males with tubercle (Fig. 16); posterior lateral edges of epigynum bulging anteriorly (Figs. 8, 13), or epigynum a triangular atrium with distinct anterior hoods separated from atrium (Fig. 17) Genus *Venatrix* Roewer 1960 4

Tip of male cymbium without claw-like setae, but with a variable number of macrosetae (Figs. 20, 21, 35, 36, 42, 43); posterior lateral edges of epigynum not bulging anteriorly, i.e. posterior lateral parts thickest at their base near the median septum (Figs. 25, 27–31, 38, 45) Genus *Hogna* Simon 1885 6

4. Carapace brown with a wide median band that constricts anteriorly of fovea and forms a star-like pattern around the fovea (Fig. 3); terminal apophysis of the male pedipalp forms a large roof over the tip of the embolus (Figs. 4, 7); bulging posterior lateral ends of epigynum whitish, median septum of equal width along its whole length (Fig. 8). TL 8.0–15.0. Aus-

tralia-wide on sand and small gravel near rivers, ponds and springs (Fig. 10) .... *Venatrix arenaris* (Hogg 1905)

Carapace brown to dark brown with a narrow light brown median band 5

5. Terminal apophysis of male pedipalp sickle-shaped (Figs. 11, 12); epigynum inverted T-shaped, the median septum widening anteriorly (Figs. 13); TL 8.0–17.0 mm. Mainly at artesian springs, rarely found near rivers (NSW, SA, Vic) (Fig. 14) .... *Venatrix fontis* Framenau & Vink 2001

Terminal apophysis of male pedipalp forms a roof over the tip of the embolus (Figs. 15); female epigynum a triangular atrium (Fig. 17); TL 5.0–11.0 mm. Open, vegetated areas near water, Australia-wide (Fig. 18), also in New Zealand and New Caledonia .... *Venatrix goyderi* (Hickman 1944)

6. Carapace dark reddish-brown, appears dark grey to black due to a dense cover of silver-grey setae (in particular in fresh material); no light median band; abdomen dark grey with indistinct light and dark patches (Fig. 41); pedipalp Figs. 42–44; epigynum Figs. 45, 46; TL 8.5–20.0 mm. Near water (SA, Qld, NSW, WA) (Fig. 47) ... ***Hogna kuyani*** new species

Carapace brown with a distinct light median band 7

7. Light median band on carapace wide, covering approx. one third of carapace width (Fig. 33); venter yellow with two black spots behind epigastric furrow and a variable number of black spots laterally (Fig. 34); pedipalp Figs. 35–37; epigynum Figs. 38, 39; TL 9.5–18.0 mm. Near water (SA, Qld, NSW, Vic) (Fig. 40) ..... ***Hogna diyari*** new species

Light median band on carapace narrow, covering less than a quarter of carapace width (Fig. 19), submarginal band with three dark blotches (sometimes not very distinct); venter uniformly yellow-brown; pedipalp Figs. 20, 21, 24; epigynum Figs. 25–31; TL 7.0–20.0 mm. Open areas near water on sand or grass, inland and coastal (Australia-wide, including offshore islands and reefs (Fig. 32); also in New Zealand and Pacific islands) .... *Hogna crispipes* (L. Koch 1877)

8. Median apophysis of male pedipalp with triangular apical process and a broad, ventrally bent tip (Figs. 59); pedipalp patella and tibia bright yellow; pedipalp tibia and basal half of cymbium with dense cover of white setae (very conspicuous in unpreserved specimens); epigynum forms an indistinct, lightly sclerotized posterior atrium (Fig. 61); carapace black with light marginal bands due to a dense cover of white setae; TL 3.5–6.0 mm. Open, but shaded areas near water, mound springs and lowland river floodplains (SA, Vic) (Fig. 62) ..... *Artoria howquaensis* Framenau 2002

Median apophysis of male pedipalp in ventral view shaped like an upside-down sock (Fig. 65), pedipalp patella light brown, cymbium without white setae; epigynum forms an oval atrium with a sclerotized posterior rim that reaches into the center of the atrium (Fig. 68); carapace brown with light median and submarginal bands and dark radial pattern (Fig. 63); femora of all legs with dark annulations (particularly distinct on ventral side of leg III and IV); TL 3.5–8.5 mm. Rare at artesian Springs, but very common in open, moderately moist cultural landscapes and suburban areas (NSW, SA, Tas, Vic) (Fig. 70) .... ***Artoria victoriensis*** new species

TAXONOMY

Subfamily Lycosinae Simon 1898

Remarks.—The Lycosinae appear to be well-defined since Dondale (1986) established synapomorphic characters for the male pedipalp (p. 331): "median apophysis transverse, with ventrally directed spur" and "median apophysis with sinuous channel on dorsal surface". However, there are difficulties in establishing monophyletic taxa below the subfamily level. Molecular analysis suggests that Dondale's (1986) '*Trochosa*-' and '*Lycosa*-groups' within the Lycosinae, based on the shape of the terminal apophysis, are paraphyletic (Vink et al. 2002). Alternatively, Zyuzin (1993) distinguished his tribes Trochosini and Lycosini based on the shape of the median apophyis ('tegular apophysis, TA' sensu Zyuzin 1993) and the female epigynum.

Genus *Venatrix* Roewer 1960

Venatrix Roewer 1960: 745 (name first listed as a *nomen nudum* in Roewer 1955: 307).

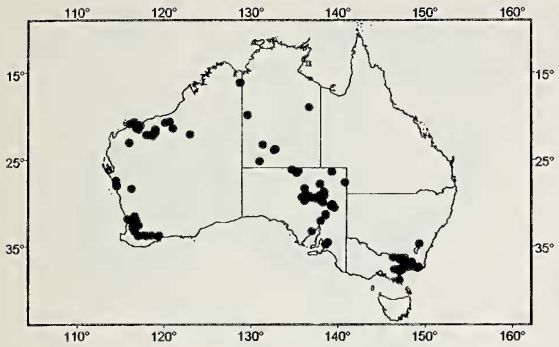


Figure 10.—Records of *Venatrix arenaris* (Hogg 1905) in Australia.

Remarks.—*Venatrix* was established by Roewer (1960) and recently revised to include 22 Australian species, of which one, *V. goyderi*, is also found in New Zealand and New Caledonia (Framenau & Vink 2001; Vink 2002; C.J. Vink, pers. comm.). Males of *Venatrix* have a tubercle on the outer edge of the fangs (Fig. 16) and large, claw-like setae at the tip of the cymbium (Figs. 4, 5, 11, 15). Three species of *Venatrix* are present at artesian springs and bore drains of South Australia, *V. arenaris*, *V. fontis* and *V. goyderi*. Full taxonomic bibliographies for these species can be found in Framenau & Vink (2001), but updated distribution maps are provided here.

Venatrix arenaris Hogg 1905
Figs. 3–10

Lycosa arenaris Hogg 1905: 586–588, fig. 88; McKay, 1974: 1–6, figs. 1a–m.

Lycosa celaenica Rainbow 1917: 488–489, plate 32, figs. 10, 11.

Venatrix arenaris (Hogg 1905): Framenau and Vink 2001: 960–962, figs. 40a–f, 41.

Diagnosis.—*Venatrix arenaris* is a medium-sized spider (TL 8.0–15.0). Its mottled, indistinct coloration varies from very dark to light beige (Fig. 3) and blends very easily with its preferred sandy habitat. Most specimens, except very dark spiders, have a light narrow band on the anterior half of the sternum. Males are distinguished by their broad terminal apophysis, which bends ventrally forming a roof over the tip of the embolus (Figs. 4, 5, 7). The female epigynum forms an inverted 'T', with a narrow median septum. The lateral tips of the posterior transverse part bulge anteriorly (Fig. 8).

Distribution and habitat preferences.—*Venatrix arenaris* is found Australia-wide (Fig. 10). It is present in most artesian springs and bore drains in South Australia, and is the dominant species in the south-eastern springs from the Blanche Cup in the west to Mulligan Springs in the east (Table 1). Within springs *V. arenaris* typically resides next to the edges of open wet spaces and small open water pools. It is rarely active during the day and usually conceals itself under *C. laevigatus*. At night this species can be observed foraging on the surface of still water.

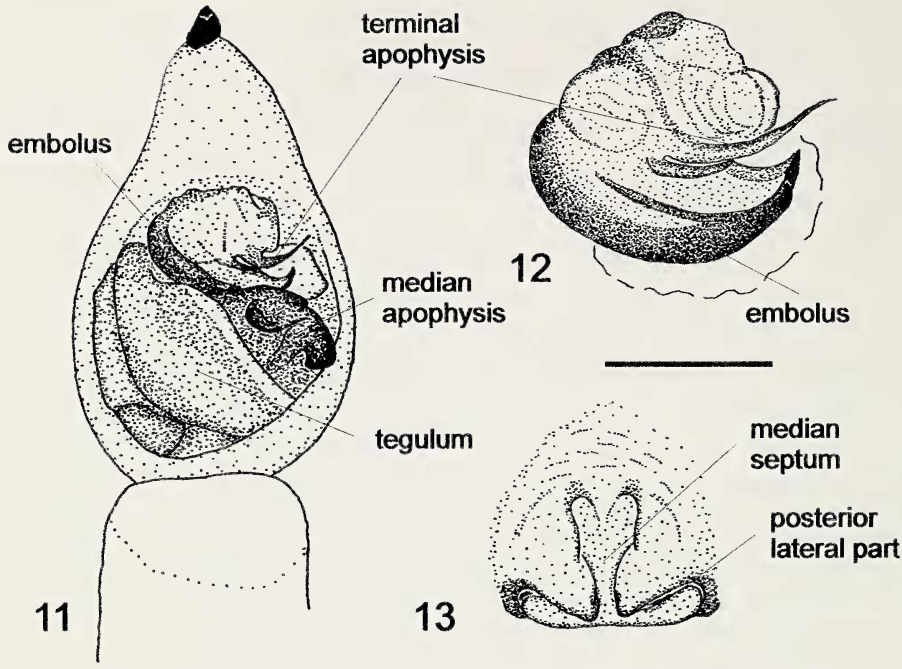
Remarks.—Recent preliminary allozyme studies indicate that *V. arenaris* populations from the South Australia and those inhabiting lowland floodplains of the Great Dividing Range in south-eastern Australia (illustrated in Framenau & Vink 2001) possibly represent two different species (Gotch 2003; M. Adams pers. comm.). Thus, the status and distribution of *V. arenaris* as presently defined on morphological grounds needs to be reassessed in conjunction with more detailed allozyme studies. Representative male and female specimens from South Australia are illustrated here (Figs. 3–9).

Venatrix fontis Framenau & Vink 2001
Figs. 11–14

Venatrix fontis Framenau & Vink 2001: 959–960, figs. 38–f, 39.

Diagnosis.—This is a medium-sized wolf spider (TL 8.0–17.0 mm). The carapace varies from nearly black to a light olive-grey and a narrow, yellow median band is always present. The abdomen is dark grey and has a lanceolate yellow heart mark in its anterior half. The body coloration resembles *V. goyderi*, however, *V. fontis* is generally larger. In contrast to *V. arenaris* and *V. goyderi*, the terminal apophysis of the male pedipalp of *V. fontis* is sickle-shaped (Figs. 11, 12). The female epigynum is inverted T-shaped, but in contrast to *V. arenaris*, its median guide widens anteriorly (Figs. 13).

Distribution and habitat preferences.—*Venatrix fontis* appears to have its main distribution at the South Australian artesian springs; however, single specimens have been found in Victoria and New South Wales (Fig. 14). It is the dominant species in the western and northern springs, from Coward Springs in the south to the Mt. Dutton spring complex in the north (Table 1). *Venatrix fontis* is a noc-



Figures 11–13.—*Venatrix fontis* Framenau & Vink 2001: Male from Freeling Springs, SA (SAM NN9908): 11. left pedipalp, ventral; 12. apical part of bulb. Females from Freeling Springs, SA (SAM NN9910): 13. ventral view of epigynum. Scale bar: (11) 0.59 mm, (12) 0.29 mm, (13) 0.57 mm.

turnal species that is associated with less densely vegetated springs, especially those with gravel or travertine substrates. During the day large adult *V. fontis* can be found under sheets of travertine and rocks while juveniles shelter in clumps of *C. laevigatus* at the spring margins.

Venatrix goyderi (Hickman 1944)
Figs. 15–18

Lycosa goyderi Hickman 1944: 33–34: plate 2, fig. 20.

Lycosa howensis McKay 1979b: 237–238, figs. 1a–e.

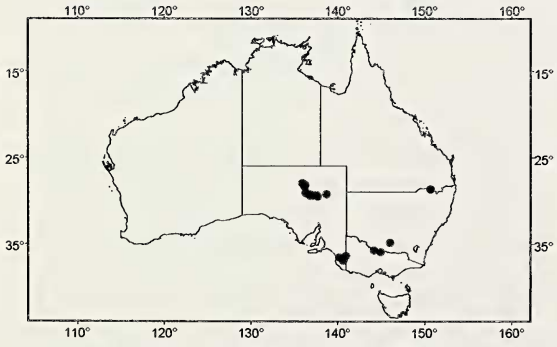
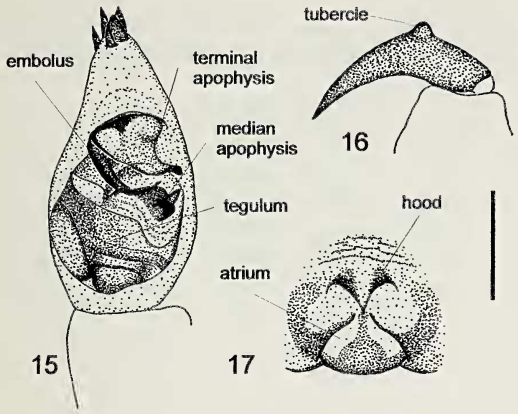


Figure 14.—Records of *Venatrix fontis* Framenau & Vink 2001 in Australia.

Venatrix goyderi (Hickman 1944): Framenau & Vink, 2001: 963–965, figs. 44a–e, 45.

Diagnosis.—This is the smallest (TL 5.0–11.0 mm) of the three *Venatrix* species found regularly at South Australian artesian springs and bore drains. This species is brown to dark brown. The carapace has a narrow, light median band. The abdomen bears a light median heart mark and pairs of light brown patches. The terminal apophysis of the male pedipalp forms a roof-like structure over the embolus (Fig. 15). The female of *V. goyderi* is the only member of the subfamily Lycosinae at the artesian springs that does not have an inverted T-shaped epigynum (Fig. 17).

Distribution and habitat preferences.—*Venatrix goyderi* has been found in all states of mainland Australia as well as Lord Howe Island (Fig. 18), the North Island of New Zealand (Framenau & Vink 2001) and recently in New Caledonia (C.J. Vink pers. comm.). In the arid zone of South Australia it is found associated with wetlands across the north-east of the state, particularly the Coopers Creek and Diamantina River systems, and with artificial wetlands such as bore drains where it is the dominant wolf spider. This species is



Figures 15–17.—*Venatrix goyderi* (Hickman 1944): Male from Howqua River, Vic (AM KS58209): 15. left pedipalp, ventral; 16. fang with tubercle. Female from Howqua River, Vic (AM KS58206): 17. ventral view of epigynum. Scale bar: (15) 0.43 mm, (16) 0.41 mm, (17) 0.31 mm.

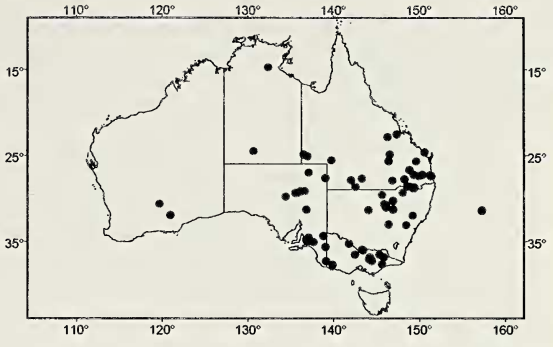


Figure 18.—Records of *Venatrix goyderi* Hickman in 1944 Australia.

also found in large numbers at springs that have been exposed to significant disturbance from over grazing, dredging or from severe floods such as at Buttercup Springs (Table 1).

Remarks.—The holotype female of *V. goyderi* had been reported lost (McKay 1985; Framenau & Vink 2001), however, it was recently discovered at the Australian Museum in Sydney (AM KS49705, VWF, examined) confirming the identity of this species.

Genus *Hogna* Simon 1885

Remarks.—*Hogna* was first listed by Simon (1885), and subsequently (Simon 1898: 347) defined mainly based on somatic characters, in particular the arrangement of the eyes and the correlation of the length of leg segments of the fourth leg. The type species is *H. radiata* (Latreille 1817), a common species in the Mediterranean region, that is found across Central Asia and Central Africa (Platnick 2004).

Currently, *Hogna* includes more than 200 species (Platnick 2005), however, the genus is in need of revision (Dondale & Redner 1990). Here we place three lycosids from South Australian artesian springs in this genus due to the similarity of their male and female genitalia with those of *H. radiata* as illustrated by Fuhn & Niculescu-Burlacu (1971) and Miller (1971). One of the artesian spring species, *H. crispipes*, is transferred from *Lycosa* Latreille 1804, the two other species are new to science, *H. diyari* new species and *H. kuyani* new species.

The examination of type material of Australian wolf spiders to establish the identity of the artesian spring species revealed that the genitalic morphology of *Pardosa pexa* Hickman 1944 (holotype male, AM KS17123, from 'Burts Waterhole' (SA), examined by VWF) is very similar to the species here placed in *Hogna*. Consequently, we transfer *Pardosa pexa* to *Hogna*: *Hogna pexa* (Hickman 1944) new combination. This new generic placement also reflects the true subfamily status of this species, as it clearly belongs to the Lycosinae and not Pardosinae (*sensu* Dondale 1986).

Hogna crispipes (L. Koch 1877) new combination
Figs. 19–32

Lycosa crispipes L. Koch 1877: 923–925, plate 79, figs. 8, 8a, plate 80, figs. 1, 1a; Rainbow 1911: 266; McKay 1979a: 253, figs. 4e–f, m; McKay 1985: 76; Platnick 1989: 370.

not *Lycosa crispipes* L. Koch 1877 sensu McKay 1979a 252–255, figs. 4a–d, g–l (misidentification, not *L. crispipes* but two undescribed species).

Lycosa pulvere-sparsa L. Koch 1877: 941–942, plate 79, fig. 2; Rainbow 1911: 272. NEW SYNONYMY.

Tarentula tongatabuensis Strand 1911: 207; Strand 1915: 258, plate 14, fig. 21, plate 19, fig. 99. NEW SYNONYMY.

Tarentula tanna Strand 1913: 121–122; Strand 1915: 260, plate 19, fig. 96a–b; Ledoux & Hallé 1995: 7. NEW SYNONYMY.

Lycosa waitei Rainbow 1917: 487–788, plate 32, figs. 7–9; Roewer 1955: 272; McKay 1973: 380; Bonnet 1957: 2669; McKay 1985: 84. NEW SYNONYMY.

Table 1.—Distribution and relative abundance of lycosid species at a selection of artesian springs and bore drains in South Australia (+++ dominant species, ++ subordinate species, + rare species); see Fig. 1 for geographical location for each site.

	Species								
Sample Locations	*Artoria howquaensis* Framenau 2002	*Artoria victoriensis* new species	*Hogna crispipes* (L. Koch 1877)	*Hogna diyari* new species	*Hogna kuyani* new species	*Tetralycosa arabanae* new species	*Venatrix arenaris* (Hogg 1905)	*Venatrix fontis* Fr. & V. 2001	*Venatrix goyderi* (Hickman 1944)
ARTESIAN SPRINGS									
Dalhousie (A)									
Dalhousie							++		
Kingfisher		+						++	
Neales River (B)									
Freeling			++					+++	
Hawker							+	+++	
Outside	++							+++	
Lake Cadibarrawirracanna (C)									
Lake Cadi				++					
Francis Swamp (D)									
Big Depot							++	+++	
Francis Swamp		+		++		++	+	+++	
Billa Kalina (E)									
Billa Kalina							+++		++
Margaret River (F)									
Blanche Cup	+++			+		+	+++		
Bubbler	++						++	+++	
Buttercup	++					++	++	+	
Coward			+					+++	
Elizabeth	++		+			+	+	+++	
Horse	+++					++	+++	++	
Jersey	+++			+		++	++	+++	
Kewson Hill							++		
Little Bubbler	++						++		
Lake Eyre South (G)									
Fred	+++		++	++			+++		++
Gosse	+++		+			++	++	++	++
McLachlan	+++					+	++		
Smith						++		+	
Hermit Hill (H)									
Bopeechee	++						+++		
Dead Boy	+++						++		
Hermit Hill	+++			+	++	+	+++		
Old Finniss	++		+		++	++	++		
Old Woman	++				+		++		
Sulphuric	+++						+++		
West Finniss	++						+++	++	
Wangianna/Davenport (I)									
Davenport							+++		
Welcome							+++		

Table 1.—Continued.

Sample Locations	Species								
	Artoria howquaensis Framenau 2002	*Artoria victoriensis* new species	*Hogna crispipes* (L. Koch 1877)	*Hogna diyari* new species	*Hogna kuyani* new species	*Tetralycosa arabanae* new species	*Venatrix arenaris* (Hogg 1905)	*Venatrix fontis* Fr. & V. 2001	*Venatrix goyderi* (Hickman 1944)
BORE DRAINS									
Hamilton (a)							+++		
Welcome (b)							+++		
Elizabeth (c)	++					++			
Coward (d)	++			+			+++		
Charles Angus (e)	+++		++				+++		
Morris Creek (f)	+++		++		++	++	++	+	+++
Crows Nest (g)							++		
Coranna (h)			++						
Muloorina (i)							+++		++
Lake Letty #3 (j)									++
Clayton (k)				+	++		+		+++

Lycosa (?) immansueta Simon 1909: Rainbow 1915: 787 (misidentification).

Lycosa strenua Rainbow 1920: 260–261, plate 30, figs. 92–93 (preoccupied by *Lycosa strenua* Nicolet 1849 and *Lycosa strenua* Thorell 1872). NEW SYNONYMY.

Lycosa tanna (Strand 1913): Berland 1938: 182–183, figs. 147–149; Bonnet 1957: 2666.

Tarentula rainbowi Roewer 1951: 442 (replacement name for *Lycosa strenua* Rainbow 1920). NEW SYNONYMY.

Hygrolycosa crispipes (L. Koch 1877): Roewer 1955: 261; Rack 1961: 37; McKay 1973: 380.

Lycosa rainbowi (Roewer 1951): Roewer 1955: 272; McKay 1985: 82.

Scaptocosa tongatabuensis (Strand 1911): Roewer 1955: 291.

Varacosa pulveresparsa (L. Koch 1877): Roewer 1955: 305; Rack 1961: 38; McKay 1973: 381.

Varacosa tanna (Strand 1913): Roewer 1955: 305; Chrysanthus 1967: 424, figs. 73, 78–79.

Lycosa tongatabuensis (Strand 1911): Bonnet 1957: 2667.

Lycosa pulveresparsa L. Koch 1877: McKay, 1985: 82.

"*Lycosa*" *tongatabuensis* (Strand 1911): Ledoux & Hallé 1995: 7, figs. 5a–c.

Geolycosa tongatabuensis (Strand 1911): Platnick 1998: 554; Vink 2002: 36–37, figs. 31, 38, 65, 92.

Types examined.—Lectotype (designated here) of *Lycosa crispipes*, 1 female, Queensland, Bowen, 20°00′S, 148°14′E, BMNH, 1919.9.18.222. Paralectotype of *Lycosa crispipes*, 1 female, Queensland, Bowen, 20°00′S, 148°14′E, Museum Godeffroy 14572, Rack (1961)-catalogue 450 (ZMH).

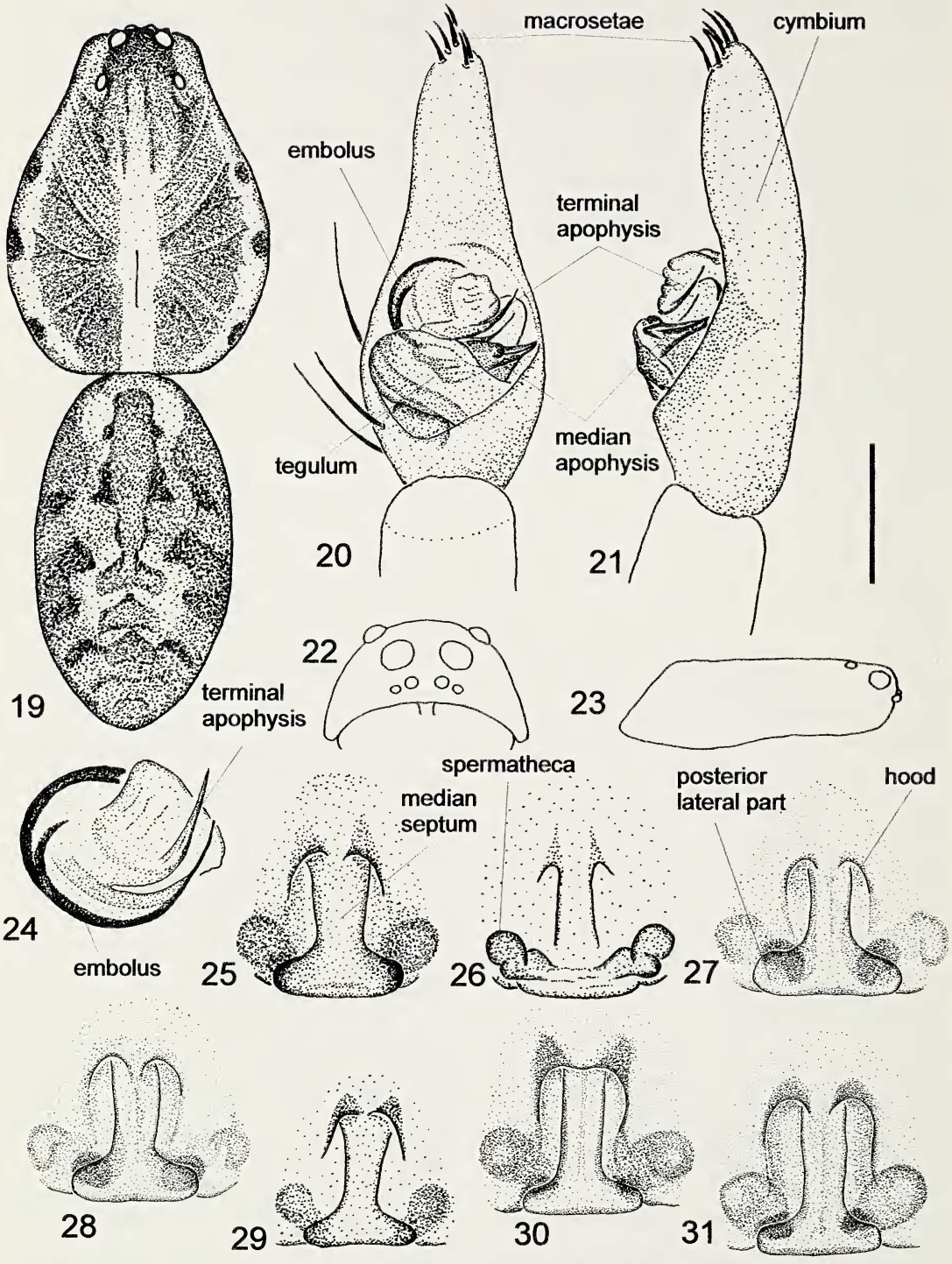
Syntype of *Lycosa pulvere-sparsa*, 1 female, Rockhampton 23°22′S, 150°30′E, Museum Godeffroy 14554, Rack (1961)-catalogue 476 (ZMH). The whereabouts of a second syntype of *Lycosa pulvere-sparsa* from 'Bradley's Collection' listed by L. Koch (1877) is unknown to VWF.

Lectotype (designated by Vink 2002) of *Tarentula tongatabuensis*, 1 female, Tonga, Tongatupu Nuku'alofa, 21°07′S, 175°12′W, 4.vi.1909, E Wolf, 1909 (SMF 2199). Paralectotype of *Tarentula tongatabuensis*, 1 juvenile, same data as lectotype (SMF).

Holotype of *Tarentula tanna*, 1 female, Vanuatu, Tanna, 19°30′S, 169°20′E, 23.v.1909, E. Wolf (SMF 2167).

Holotype of *Lycosa waitei* Rainbow 1917, 1 female, South Australia, Coopers Creek, ca. 28°23′S 137°41′E, September/October 1916, South Australian Museum Expedition to the Interior (SAM NN380).

Holotype of *Lycosa strenua* Rainbow 1920,



Figures 19–31.—*Hogna crispipes* (L. Koch 1877): Male from Cullyamurra Waterhole, SA (SAM NN13955): 19. habitus; 20. left pedipalp, ventral; 21. left pedipalp, retrolateral; 22. eye arrangement; 23. lateral view of carapace; 24. apical part of bulb. Female: 25. ventral view of epigynum (WAM T47310, from Fred Springs, SA); 26. dorsal view of epigynum (WAM T47310); 27. ventral view of epigynum (lectotype from Bowen, Qld; BMNH 1919.9.18.222); 28. ventral view of epigynum (paralectotype from Bowen, Qld; ZMH 450); 29. ventral view of epigynum (lectotype of *Tarentula tongatabuensis* Strand

1 female, New South Wales, Norfolk Island, 29°02′S, 167°57′E, A.M. Lea, December 1915–January 1916 (SAM NN277).

All types examined.

Other material examined.—AUSTRALIA: *South Australia*: 1 ♂, Bakers Creek, N of Wilpena (QM S21408); 1 ♂, 1 ♀, 1 juv. Charles Angus Bore (SAM NN13945–6); 22 ♂, 8 ♀, 1 ♀ with eggsac, 39 juv., Coongie Lake (SAM NN13979–82, NN13983–4006, NN14108–10); 1 ♂, 1 ♀, Coongie Lake, 1.77 km W (SAM NN13977, NN20979); 1 ♀, Coongie Lake, 50 m SSW (SAM NN13976); 1 ♀, Coongie Lake, 700m E (SAM NN13978); 1 ♀, Coongie Lake, 7 km SE (SAM NN13975); 6 ♂, 8 juv., Coranna Bore (WAM T47304, T47308–9); 1 ♀ with 116 spiderlings, Coward Springs (SAM NN13948); 3 ♀, 1 juv., Culburra (QM S61110); 15 ♂, 5 ♀, 1 juv. (SAM NN13955–74); 1 ♂, Dickinna Hill, 9.5 km SW (SAM NN13954); 1 ♀, Elizabeth Springs (Nth B) (SAM NN13938); 5 ♀, Finnis Springs (SAM NN13139–40); 6 ♂, 2 ♀, Fred Springs (SAM NN13941–2, WAM T47302–3, T47305, T47307, T47310); 1 ♂, Freeling Spring (SAM NN13947); 1 ♂, Gosse East Spring (SAM NN13937); 1 ♂, 1 juv., Greenfields Wetlands, Dry Creek, Salisbury (SAM NN14010); 1 ♀, Johnsons Dam, Granite Downs Station (SAM NN13953); 1 ♂, 1 juv., Karroongooloo Station, via Adelaide (MV K8147); 1 ♂, Lake Hope channel, 3.9 km S Lake Appadare (SAM NN13949); 1 ♂, Lake S Siccus River (Koonamoore Station?) (SAM NN14007); 1 ♂, Maslins Beach (SAM NN14012); 1 ♂, 2 ♀, Morris Creek Bore (SAM NN13943–4; WAM T47306); 1 ♂, Mt Fairview, Paney Station (SAM NN14008); 1 ♀, Scott Creek Weir (AM KS32122); 1 ♀, Todmordon, 90 miles W Oodnadatta, Capt. SA White Expedition, published in Rainbow (1915) as *Lycosa (?) immansueta* (SAM NN411); 1 ♂, Twin Hill (SAM NN13951); 1 ♀, Windsor Gardens, Adelaide (SAM NN14011). *New South Wales*: 2 ♀, no location (NSW?), W.J. Rainbow manuscript no. 115 (AM KS84107); 1 ♀, no location (NSW?), W.J. Rainbow manuscript no. 78 (AM KS84109); 1 ♀, Armidale (AM KS84106); 15 ♂, 17 ♀, Bowra Station, 350 m past entrance, N of Carinda (AM KS76337–40, KS76743); 1 ♀, Broken Hill (SAM NN14123); 1 ♂, Clarence River, Copmanhurst (SAM NN14013); 1 ♀, Coolaba Ramsey Park (AM KS42374); 1 ♂, Cootamundra (AM KS84103); 1 ♂, 1 ♀, Darling River, 1.5 km South of Trilby Station (AM KS76557, KS76562); 3 ♂, 1 ♀, Gwydir Highway, 300 m N of Minnamurra Station turnoff (AM KS76554, KS76561, KS76564); 2 ♂, 1 ♀, Hunter Valley AM KS7322); 1 ♀, Lord Howe Island (AM KS68547); 3 ♂, 1 ♀, Merri Merri Creek, 2.5 km North of Quambone (AM KS76553, KS76559–60); 14 ♂, 3 ♀, Mullingar Station, Lower Murray-Darling region (AM KS67036–7); 1 ♂, 1 ♀, 5 juv., Narrabri (AM KS84102); 3 ♂, 3 ♀, Narran Lakes Reserve access track, 6.5 km from Narran Lakes Road (AM KS76550–2, KS76563); 3 ♀, 1 ♀ with eggsac, Norfolk Island (AM KS43951–2, KS43954, KS68883); 1 ♀, Norfolk Island, Burnt Pine (AM KS49891); 2 ♀, Norfolk Island, Captain Cook Memorial (ANIC); 1 ♀, Norfolk Island, Duncombe Bay (AM KS49895); 2 ♀, Norfolk Island, Mill Road (AM KS43953); 1 ♀, Nyngan-Canonba Road, 2.9 km South of Fairview Station junction (AM KS76555); 1 ♂, Road to Wanaaring, 12.7 km W of Mitchell Hwy junction (AM KS76284); 1 ♂, Spring Hill Station, Lower Murray-Darling region (AM KS66736); 1 ♂, Sturt National Park, 19.2 km S of Fort Gray Homestead on Cameron Corner Rd (AM KS84105); 1 ♂, Warren-Quambone Road, 0.7 km N of turnoff to Wyndabyne Station (AM KS76556); *Northern Territory*: 1 ♀, Cox River (SAM NN13129); 1 ♀, Curtin Springs (ANIC); 1 ♀, 2 juv., Tobermory Station, No. 8 Dam (QM S61119). *Queensland*: 1 ♀, Appel Channel, Mornington Island (SAM NN14015); 1 ♂, 2 juv., Barrow Creek (QM S21407); 6 ♀, Birdsville (QM W7186); 1 ♂, 1 ♀, Birdsville, near town (QM W6117); 2 ♂, 1 ♀ with eggsac, 2 ♀, 1 juv., Bowen (QM

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from Tonga; SMF 2199); 30. ventral view of epigynum (holotype of *Lycosa watei* Rainbow from Coopers Creek, SA; SAM NN380); 31. ventral view of epigynum (holotype of *Lycosa strenua* Rainbow from Norfolk Island, NSW; SAM NN277). Scale bar: (19) 2.13 mm, (20–21) 0.48 mm, (22) 1.37 mm, (23) 2.55 mm, (24) 0.14 mm, (25–31) 0.65 mm.

S21412); 1 ♀, Bushy Island, Great Barrier Reef (QM S61116); 1 ♀, Cape Tribulation (QM S61108); 1 ♀, Claudie River mouth (QM S61131); 1 ♂, 2 ♀, Cluny Station Billabong (QM S61066); 1 ♀, Coopers Creek, between Cluny Station and Monkira (QM S61104); 3 ♂, 4 ♀, 7 juv., Curtis Island, S end of township (QM S61096S61103); 1 ♂, Eulo, 'Cookara' (QM S61098); 1 ♀ with eggsac, 2 ♀, Eurithethera Soak, Toomba Range (QM W7185); 2 ♀, 1 juv., Farmer Island, Great Barrier Reef (QM S61128); 1 ♀, 1 juv., Frederick Reef, North Reef Cay, Coral Sea (ANIC); 26 ♂, 7 ♀, 2 juv., Gatton, Queensland Agricultural College (QM S61069–71, S61074–9, S61081–5, S61087–90, S6112–4); 1 ♂, Grey Range, central tank, 'Orient' (QM S61099); 2 ♀, Halfway Islet, Great Barrier Reef (QM S61126); 1 ♂, 3 ♀, 1 juv., Hannah Point, North Molle Island (QM S61100); 6 ♂, 1 ♀, Jondaryan, 20 km S (QM W7189); 3 ♂, 5 ♀, 2 juv., Jumbo Bore, 'Norley', Thargomindah (QM S61101); 1 ♂, Lake Broadwater (QM S61095); 1 ♂, Lake Broadwater, near cottage (QM S61080); 1 ♀, Lake Hutter, N of Aramac (QM S61113); 1 ♂, 1 ♀, Lake Nuga Nuga (QM S61068); 1 ♂, Longreach (SAM NN14014); 1 ♀, Lucinda (QM S21414); 1 ♀, 1 juv., Lydeman Island, Great Barrier Reef (QM S61129); 1 ♀, MacArthur Cay, Great Barrier Reef (QM S61121); 2 ♀, Magra Islet, Great Barrier Reef (QM S61127); 1 ♀ with eggsac, 1 juv., Maydelaine Island (ANIC); 28 ♂, 31 ♀, 4 juv., Muncoonie Lakes (QM W6413–6, W7187); 1 ♂, Mundingburra (AM KS86384); 1 ♂, Murrumba Downs (QM S61093); 1 ♀, Pelican Island (QM S61125); 1 ♂, 1 ♀, 2 ♀ with eggsac, 3 juv., Raine Island (WAM T55434; QM S61073, S61145–7); 1 ♀, 1 juv., Saunders Islet, Great Barrier Reef (QM S61118); 1 ♀, Sherrard Island, Great Barrier Reef (QM S61120); 1 ♀, Stainer Islet (QM S61107); 1 ♀, Thargomindah (QM W7188); 1 ♀, 1 juv., Thursday Island, Nth side (QM S17225); 1 ♀, Tingalpa (QM S26112); 2 ♀, Townsville, common wetlands (QM S61094); 1 ♀, Townsville, Community Environmental Park (QM S61114); 1 ♀, 1 ♀ with eggsac, 1 ♀ with spiderlings, Townsville, near Fishermans Wharf (QM S61106, S61133); 1 ♂, Turtle Islet, Lihou Reef, Coral Sea (ANIC); 1 ♀, Vanrook Station, Gilbert River Crossing West side (AM KS44298); 1 ♀, Wenlock River (QM S21409). *Victoria*: 1 ♂, Avon River near Valencia Creek (WAM T47111); 2 ♂, 1 ♀, Barmah Forest (WAM T47112–3); 3 ♂, 2 juv., Booths Rd, 0.2 km S Murray Valley Hwy (MV K8771); 4 ♀, Murray Valley Hwy, 0.3 km NNW Walshs Bridge (MV K8691); 1 ♀, Murray Valley Hwy, Deep Ck Crossing (MV K8774); 1 ♀, Redcliffs (MV K8258). *Western Australia*: 1 ♂, 1 ♀, Amelia Heights (WAM 69/2072, 71/939); 1 ♀ with spiderlings, Argyle Downs Homestead, edge of Behn River (QM W5058); 2 ♀, Ashmore Reef, East Islet (AM KS68684); 1 ♂, 3 ♀, Attadale (WAM 71/900, 71/985–6, 71/1448); 1 ♀, Avon River, Northam (WAM 71/987); 1 ♂, Baskerville (WAM T47248); 6 ♂, 3 ♀, Beacon, ca. 15 km S, Askew Road (WAM T47147); 1 ♀ with spiderlings, Behn River, Argyle Downs, Ord River area (QM W5060); 1 ♂, Broome (WAM T47240); 2 ♀ with eggsac, Cannington (WAM 71/774, 71/838); 1 ♀, Carmel (AM KS86382); 1 ♂, Chillmoney Road, North, SW Binnu (WAM T47132); 5 ♂, Chillmoney Road, SW Binnu (WAM T47227); 1 ♀, 1 juv., Christmas Island, 1.5 miles N of South Point (ANIC); 1 ♀, Christmas Island (QM S61132); 1 ♂, 3 ♀, 2 juv., Cocos Keeling Island (QM S61134); 1 ♂, 6 ♀, Coolinup Nature Reserve (WAM T47130, T47141); 1 ♀, Cottesloe (WAM T53622); 4 ♂, Dumbleyung Lake North (WAM T47131, T47238); 1 ♀, Eneabba, AMC mine (WAM T553137); 1 ♀, Esperance (WAM 71/898); 1 ♀, Faure Island, Shark Bay (SAM NN14128); 12 ♂, 40 ♀, 5 juv., Goongarrie (WAM T48123, T48166); 1 ♀, Grass Patch, E of, 'Sieda' (WAM T53580); 1 ♀, Gunyidi, ca. 12 km W (WAM T47142); 1 ♀, Gutha, 37 miles North (WAM T51547); 2 ♀, Home Island, Cocos-Keeling Islands (ANIC); 1 ♂, 1 ♀, Jarrahdale (WAM T55768–9); 1 ♀, Kirwan (WAM 71/984); 4 ♂, Lake Bryde East Nature Reserve, Lake Bryde Rd (WAM T47146); 2 ♂, Lake Bryde West Nature Reserve, Lake Bryde Rd (WAM T47139); 1 ♀, 12 juv., Lake Cronin (WAM T48124); 1 ♀, Lake Gruszka (WAM T51548); 1 ♂, Lake Gulson, 65 km SE of Hyden (WAM T51474); 1 ♂, Lake Mollerin (WAM T47222); 6 ♂, 2 ♀, 1 juv., Lake Ninan Shire reserve (WAM T47143); 12 ♂, 2 ♀, 3 juv., Little Sandy Desert, 23.1 km ESE of Burranbar Pool (WAM T53420–2); 7 ♂, 24 ♀, 8 juv., Little Sandy Desert, 23.3 km ESE of Burranbar Pool (WAM T53417–9); 1 ♀, 2 juv., Lorna Glen

Station (WAM T55132); 1 ♂, Maitland River (WAM 71/1517); 1 ♀, Marangaroo (AM KS86383); 1 ♀, Mellish Reef (WAM T51413); 1 ♂, 1 ♀, Morawa-Perenjori Road (WAM T47144); 1 ♂, Mortlock Creek, Wongan Hills (WAM 99/1103); 1 ♀ with spiderlings, Murchison River (QM S61111); 1 ♀, Myaree (WAM T53532); 1 ♂, Nedlands (WAM T53461); 1 ♂, Noranda (WAM T53535); 1 ♂, Nugadong West Rd, SW Wubin (WAM T47136); 1 ♂, Nullagine (WAM T55307); 1 ♂, 1 ♀, Nullewa Lake (WAM T47140); 1 ♂, Oakajee Nature Reserve (WAM T47221); 1 ♀, Parry Creek Billabong (WAM T53691); 2 ♂, 2 ♀, 3 juv., R.G.C. Mine, 10 km S of Eneabba (WAM T51397–9); 5 ♂, 5 ♀, 3 ♀ with eggsac, Rossmoyne (WAM 71/561–2, 71/740, 71/835–7, 71/867–70, 71/940, 71/1446, T48122); 1 ♀, Separation Well (WAM T53510); 1 ♀, South Lake, near Perth (WAM T53508); 1 ♂, 2 juv., The Loop, Murchison River (WAM T53662); 1 ♀, 1 juv., Thirsty Point Waterhole, 1.5 miles E (WAM 71/1447); 1 ♀, Toolibin Lake (WAM T47133); 1 ♂, 3 ♀, Walkaway Nature Reserve (WAM T47135, T47235); 1 ♀, Wanneroo Lake (WAM 69/2071); 1 ♀ with eggsac, Warburton Ranges (WAM T53812); 1 ♂, 1 juv., Warr Well (WAM T51555); 1 ♀, Weelhamby Lake (WAM T47274); 1 ♀, Wittenoom Rd near Dempster Rd junction, E Gibson (WAM T47148); 1 ♀, Yannarie River at North West Coastal Hwy (WAM T53493). NEW CALEDONIA: 1 ♀, no exact location (SAM NN13935). VANUATU: 1 ♂, Espiritu Santo, Malac Village (SAM NN13936); 2 ♀, 2 juv., Malekula (AM KS84104). SOLOMON ISLANDS: 1 ♀, Vanikoro, Santa Cruz Group (AM KS84108).

Diagnosis.—The male and female genitalia of *H. crispipes* are very similar to those of *H. diyari* and *H. kuyani*. However, all three species can be easily distinguished by their color pattern (Figs. 19, 33, 41). Whereas the median band in *H. crispipes* is narrower than one-fourth the carapace width, it is one-third the width of the carapace in *H. diyari* and absent in *H. kuyani*.

Description.—*Male:* Carapace (Figs. 19, 23): Dorsal line straight in lateral view; dark brown, with light brown narrow median band; distinct light brown submarginal bands with three dark blotches; carapace covered with brown setae in dark areas and white setae in light brown parts and eye region; few black bristles in anterior half of median band; black bristles in head region between PE and posterior of PLE; 1 long bristle between AME. Sternum: Yellow-brown; covered with white setae, denser and longer towards margins; few brown bristles. Labium: Brown; front end truncate and white. Chelicerae: Light brown; covered with white setae and few brown bristles in basal half; three retromarginal teeth, with the median slightly larger; three promarginal teeth, with the median largest. Pedipalp (Figs. 20, 21, 24): Cymbium elongated, tip with 2–6 macrosetae; terminal apophysis sickle-shaped (Figs. 20, 24). Abdomen: Irregular dark grey; irregular yellow-brown median band; brown lanceolate heart mark with indistinct darker edges, that continues into a triangular, dark grey pattern in posterior half; covered with white setae and additional brown setae in darker area; venter uniformly yellow-brown and covered with white setae; spinnerets yellow-brown. Legs: Leg formula IV > I > II > III; all femora, patellae and tibiae brown, dorsally with indistinct grey annulations; metatarsi dark brown, metatarsus I with long dense hair-like setae; scopulous setae on all tarsi; spination of leg I (based on SAM NN13955): Femur: 6 dorsal, 2 apicoprolateral; patella: 1 prolateral, 1 retrolateral; tibia: 3 ventral pairs, 2 prolateral, 2 retrolateral, 1 dorsal; metatarsus: 2 ventral pairs, 1 apicoventral, 2 prolateral, 2 retrolateral, 1 apicoprolateral, 1 apicoretrolateral.

Female: Carapace: As male, submarginal blotches less distinct as the submarginal band is darker. Sternum: coloration light brown, covered with brown bristles of increasing length and density towards margins. Labium: Dark brown, front end truncate and white. Chelicerae: Dark brown, setae and bristles as male; three retromarginal teeth with the median largest, three promarginal teeth, with the median largest. Epigynum (Figs. 25–31): Ventral view: inverted T-shaped (Figs. 25, 27–31); dorsal view: round spermathecae, copulatory ducts short and twisted (Fig. 26). Abdomen: As male, pattern less distinct in particular in posterior half; venter yellowish-grey covered with brown setae; spinnerets as male. Legs: Leg formula and coloration as male; spination of leg I (based on SAM NN13970): Femur: 6 dorsal, 2 apicoprolateral; tibia: 3 ventral pairs, 1 (small) prolateral; metatarsus: 2 ventral

pairs, 1 apicoventral, 1 apicoprolateral, 1 apicoretrolateral.

Measurements: Male SAM NN13955 (female SAM NN13970): TL 10.1 (12.6), CL 5.1 (6.0), CW 4.1 (4.5). Eyes: AME 0.23 (0.26), ALE 0.17 (0.17), PME 0.46 (0.43), PLE 0.37 (0.34). Row of eyes: AE 0.92 (1.12), PME 1.09 (1.26), PLE 1.37 (1.60). Sternum (length/width) 2.4/1.95 (2.55/1.95). Labium (length/width) 0.63/0.57 (0.80/0.83). AL 5.25 (6.60), AW 2.55 (3.75). Legs: Lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): Pedipalp 1.64 + 1.95 + — + 1.5 = 5.1, I 5.50 + 5.70 + 4.05 + 2.25 = 16.80, II 4.35 + 5.25 + 3.90 + 2.4 = 15.90, III 3.75 + 4.50 + 4.05 + 2.40 = 14.70, IV 5.10 + 6.15 + 6.00 + 3.00 = 20.25 (Pedipalp 1.95 + 2.25 + — + 1.50 = 5.70, I 4.05 + 5.25 + 3.00 + 2.10 = 14.40, II 3.90 + 4.95 + 3.00 + 1.95 = 13.80, III 3.60 + 4.20 + 3.15 + 1.95 = 12.90, IV 4.95 + 6.45 + 5.40 + 2.55 = 19.35).

Variation: Males (females) (range, mean ± s.d.): TL 6.0–17.1, 9.5 ± 1.7; n = 55; CL 3.5–8.7, 4.9 ± 0.8; n = 56; CW 2.6–6.3, 3.7 ± 0.6; n = 56 (TL 8.0–21.0, 13.6 ± 2.7, n = 86; CL 4.1–10.4, 6.0 ± 1.1, n = 86; CW 2.9–7.4, 4.4 ± 0.9; n = 86).

The size variation within *H. crispipes* is considerable and populations from offshore islands and reefs appear to be on average larger than the mainland specimens, a pattern also observed in vertebrates (e.g. Lomolino 1985, Boback 2003). The three dark blotches on the lateral margins of the carapace may not be as distinct as in the specimen illustrated (Fig. 19), and may be absent in some cases.

Distribution and habitat preferences.—*Hogna crispipes* is found on mainland Australia and offshore islands and reefs in the East and West of Australia (Fig. 32), as well as in New Zealand (Vink 2002) and on several Pacific islands (e.g. Tonga, New Caledonia, Vanuatu, and the Solomon Islands). While uncommon in artesian springs, this species is widely distributed across all of the major spring groups within South Australia (Table 1). It is usually found on the edges of the springs and in the ephemeral wet zone that exists beyond the permanent vegetated wetland.

Remarks.—The original description of *H. crispipes* was based upon male and female syntypes from Bowen and Rockhampton deposited at the Museum Godeffroy (L. Koch 1877); the precise number of specimens was not stated. While two female syntypes lodged in the BMNH and ZMH were examined during this study, we could not find any male syntypes in either of these museums or in the ZMB, where the majority of the material from the Museum Godeffroy is currently lodged. These must be considered lost. In addition, L. Koch's (1877) original description and illustrations suggest that the male syntype(s) is (are) not conspecific with the females. An inverted color pattern (light instead of dark median abdominal heart mark) and the structure of the pedipalp suggest that the male specimen illustrated is *Venatrix goyderi* and not *Hogna crispipes*. To provide nomenclatural stability for the name *H. crispipes*, one of the female syntypes is here designated as the lectotype.

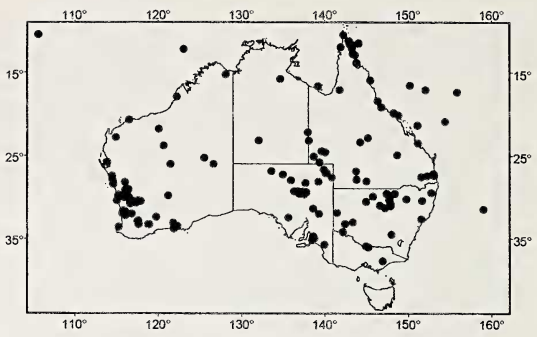
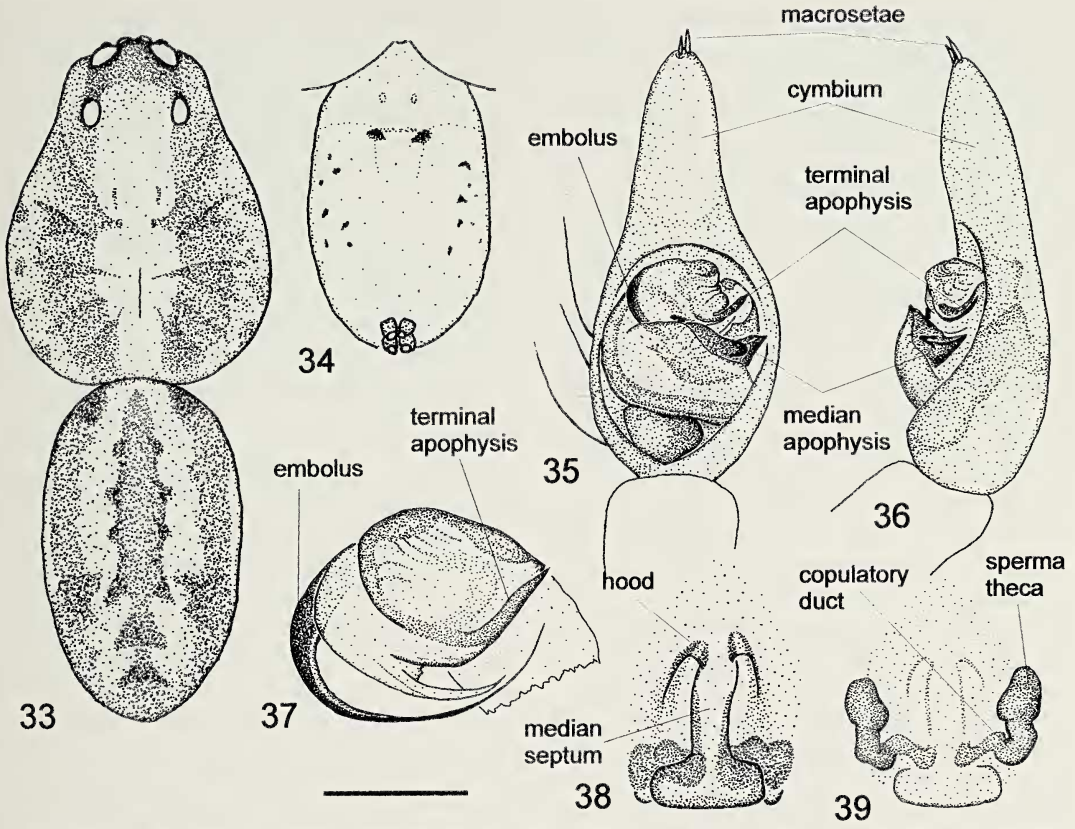


Figure 32.—Records of *Hogna crispipes* (L. Koch 1877) in Australia.

Hogna crispipes was redescribed and illustrated by McKay (1979a). A re-examination of the specimens included in McKay's revision revealed that the majority of the material is not conspecific with the type material of *H. crispipes*. Only two females from Behn River, Argyle Downs (WA) (QM W5058, W5060; McKay 1979a, fig. m) are conspecific with the female type material of *H. crispipes*. All other specimens described and illustrated belong to two undescribed *Hogna*. Although the genital morphology of both males and females of these undescribed species is very similar to *H. crispipes*, the carapace does not display the typical narrow median and blotched marginal bands, but is very similar to *Venatrix arenaris* (see Fig. 3).

The type material of *Lycosa crispipes*, *Lycosa pulveresparsa* L. Koch 1877, *Tarentula tongatabuensis* Strand 1911 (= senior syno-



Figures 33–39.—*Hogna diyari* new species: Male: 33. habitus and 34. ventral view of abdomen (holotype from Coongie Lake, SA; SAM NN14115); left pedipalp: 35. ventral and 36. retrolateral view, and 37. apical part of bulb (paratype from Coongie Lake, SA; SAM NN14116). Female (WAM T48035): 38. ventral and 39. dorsal view of epigynum. Scale bar: (33–34) 2.68 mm, (35–36) 0.73 mm, (37) 0.24 mm, (38–39) 0.70 mm.

nym of *Tarentula tanna* Strand 1913 (Ledoux & Hallé 1995)), *Lycosa waitei* Rainbow 1917 and *Lycosa rainbowi* Roewer 1951 (replacement name for *Lycosa strenua* Rainbow 1920), does not show any differences in somatic and genitalic characters that warrant status as different species. Therefore, *T. tongatabuensis*, *L. pulvere-sparsa*, *L. waitei* and *L. rainbowi* are considered junior synonyms of *H. crispipes*.

Recently, Vink (2002) placed *H. crispipes* (sub *G. tongatabuensis*) in the genus *Geolycosa*. However, this species does not conform very well to the generic description of *Geolycosa* (e.g. Dondale & Redner 1990). Vink (2002) argued that the genitalia of *H. tongatabuensis* conform more to *Geolycosa* than *Hogna*. However, comparison of the genitalic structure of *H. crispipes* with that of *H. radiata* as illustrated in Fuhn & Niculescu-Burlacu (1971) and Miller (1971) showed very good agreement. In addition, *Geolycosa* is characterized by a sloping dorsal line of the carapace, the absence of light median and submarginal bands on the carapace, and the absence of macrosetae at the tip of the male cymbium (Dondale & Redner 1990). None of these characters fit *H. crispipes*, which has a horizontal dorsal carapace profile, distinct light median and submarginal bands on the carapace, and 2–6 macrosetae on the tip of the cymbium. Therefore, *H. crispipes*, as well as the closely related *H. diyari* and *H. kuyani* are placed in *Hogna*.

Hogna diyari new species
Figs. 32–40

Types examined.—Holotype male, Australia, South Australia, Coongie Lake, 27°12′S, 140°10′E, 26–28 October 1995, on shoreline,

D. Hirst (SAM NN14115). Paratypes: 5 males, 2 females, data as holotype (SAM NN14111–14, NN14116–8).

Other material examined.—AUSTRALIA: *South Australia*: 1 ♂, Blanche Cup Mound Spring (SAM NN14083); 3 ♂, 1 ♀, 14 juv. Clayton Bore, 33 miles N of Marree (WAM 71/573–590); 1 ♂, Clifton Hills Station (SAM NN14103); 3 ♂, 1 juv., Coongie Lake (SAM NN14105–7); 1 ♂, Coongie, 6.2 km NW (SAM NN14104); 4 ♂, 6 ♀, 2 juv., Coward Springs Railway Bore (SAM NN14085–94); 1 ♀, Francis Swamp Mound Spring tail (SAM NN14084); 3 ♂, 2 ♀, Fred Springs (SAM NN14080–1; WAM T48034–6); 1 ♀, Jersey Spring (SAM NN14082); 1 ♂, Lake Cadibarrawirracanna (SAM NN14102); 2 ♀, 4 juv., Lake Hart (SAM NN14119–20); 3 ♂, 2 ♀, 2 ♀ with eggsac, Lake Hope channel, 3.9 km S Lake Appadare (SAM NN14095–101); 1 ♀, Seven Mile Creek, Clifton Hills (SAM NN141); 1 ♀, Stirtons Old Campsite, E edge of Cannuwalkaninna Dune (WAM 73/232). *New South Wales*: 1 ♂, 2 ♀, Broken Hill (SAM NN14079, NN14121–2); 2 ♂, 1 ♀, Kinchega National Park (AM KS69252, KS8410). *Queensland*: 1 ♂, Cluny Station Billabong (QM S61148); 1 ♂, Dynevor Lakes, E of Thargomindah (QM S61115). *Victoria*: 1 ♀, labeled 'Mcmillan Park, Sale. V' [possibly Sale, East Gippsland] (MV K8156).

Etymology.—The specific name is a noun in apposition honoring the Diyari people, an Aboriginal tribe representing the traditional custodians of parts of the land on which the South Australian artesian springs are found.

Diagnosis.—In contrast to the other two darker colored *Hogna* species of artesian springs, *H. crispipes* and *H. kuyani*, the carapace coloration of *H. diyari* is light brown with a wide yellow median band that constricts anteriorly of the fovea and narrows slightly posteriorly (Fig. 33). Most distinguishable is a pair of small black spots behind the epigastric furrow and up to eight spots along the lateral border of the yellow venter (Fig. 34).

Description.—*Male:* Carapace (Fig. 33): Brown, with wide yellow-brown median band that constricts anteriorly of fovea and narrows slightly in posterior half; irregular light marginal bands; head region dark brown; carapace covered with white setae, particularly in head region; additional brown setae in dark areas; six brown bristles in median band anteriorly of fovea with the posterior ones in a pair; black bristles in head region between PME and PLE, between PME and below AE. Sternum: Yellow-brown; densely covered with white setae, denser and longer towards margins. Labium: Light brown, basal half darker; front end truncate and white. Chelicerae: Basal half light brown with a dense cover of white setae and fewer brown bristles, apical half dark brown with few brown bristles; three retromarginal teeth, with the basal largest; three promarginal teeth, with the median largest. Pedipalp (Figs. 35–37): Cymbium elongated, tip with two macrosetae; median apophysis with ventral process; terminal apophysis sickle-shaped, embolus long and slender (Figs. 35, 37). Abdomen: Irregular grey brown; yellow-brown median band; brown lanceolate heart mark with dark grey patchy borders in anterior half, continuing into a triangular, dark grey pattern in posterior half; covered with white setae and additional brown setae in darker areas; few longer, brown bristles; venter yellow-brown with a pair of black spots behind epigastric furrow and irregular black spots laterally (Fig. 34); covered with white setae, black setae on black spots; spinnerets yellow-brown, with grey setae towards tips. Legs: Leg formula IV > I > II > III; tarsi and metatarsi dark brown, tibiae basally brown and apically dark brown, femora brown, femora III and IV with faint grey annulation dorsally; dense scopulous setae on all tarsi and metatarsi I and II; dense and hair-like setae dorsally on tarsi and metatarsi I and II. spination of leg I (based on holotype SAM NN14115): Femur: 6 dorsal, 2 apicoprolateral; patella: 1 prolateral, 1 retrolateral; tibia: 3 ventral pairs, 2 prolateral, 2 retrolateral; metatarsus: 2 ventral pairs, 1 apicoventral, 2 prolateral, 2 retrolateral, 1 apicoventral, 1 apicoretrolateral.

Female: Carapace: As male. Sternum: coloration as male, but fewer and shorter white setae. Labium, chelicerae and their dentition: as male. Epigynum (Figs. 38, 39): Ventral view: inverted T-shaped (Fig. 38); dorsal view: ovoid spermathecae, copulatory ducts connected posteriorly (Fig. 39). Abdomen: As male, pattern less distinct in particular in posterior half; venter and spinnerets as male. Legs: Leg formula IV > I > II > III; coloration as male; spination of leg I (based on

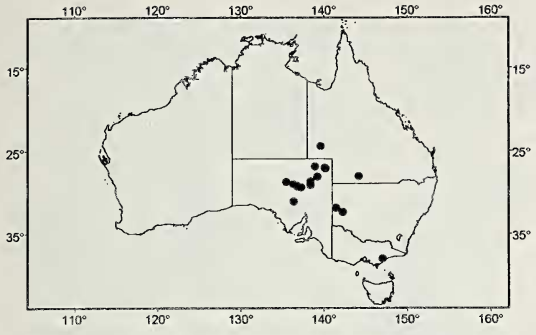


Figure 40.—Records of *Hogna diyari* new species in Australia.

paratype SAM NN14118): Femur: 6 dorsal, 2 apicoprolateral; tibia: 3 ventral pairs, 2 prolateral, 2 retrolateral; metatarsus: 2 ventral pairs, 1 apicoventral, 1 apicoprolateral, 1 apicoretrolateral.

Measurements: Male holotype SAM NN14115 (female paratype SAM NN14118): TL 13.5 (15.5), CL 6.6 (7.1), CW 5.1 (5.1). Eyes: AME 0.34 (0.29), ALE 0.26 (0.23), PME 0.71 (0.69), PLE 0.57 (0.60). Row of eyes: AE 1.34 (1.40), PME 1.66 (1.74), PLE 2.03 (2.4). Sternum (length/width) 2.8/2.6 (3.0/2.6). Labium (length/width) 0.83/0.83 (1.06/1.06). AL 7.1 (8.7), AW 4.1 (5.6). Legs: Lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): Pedipalp 2.55 + 2.1 + — + 2.1 = 6.75, I 5.85 + 7.50 + 5.40 + 2.85 = 21.60, II 5.4 + 6.75 + 5.1 + 2.7 = 19.95, III 5.10 + 6.00 + 5.40 + 2.55 = 19.05, IV 6.30 + 7.65 + 7.50 + 3.15 = 24.60 (pedipalp 1.80 + 2.55 + — + 1.80 = 5.15, I 5.25 + 6.75 + 6.90 + 2.25 = 21.15, II 5.10 + 6.15 + 5.10 + 2.10 = 18.45, III 4.50 + 5.40 + 3.90 + 2.10 = 15.09, IV 5.85 + 7.35 + 6.15 + 2.85 = 22.20).

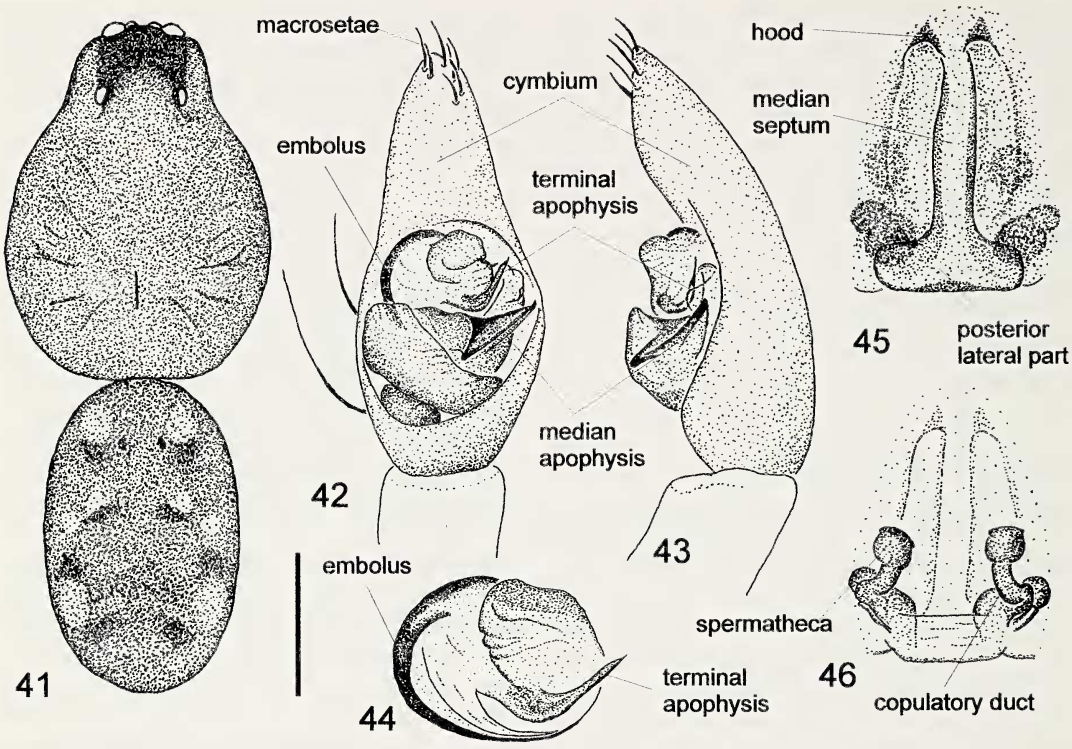
Variation: Males (females) (range, mean ± s.d.): TL 9.8–15.1, 12.1 ± 1.4; n = 23; CL 4.1–7.2, 6.0 ± 0.7; n = 25; CW 3.0–5.3, 4.3 ± 0.5; n = 25 (TL 12.7–17.6, 14.9 ± 1.4, n = 20; CL 5.9–8.1, 6.8 ± 0.7, n = 20; CW 4.2–6.5, 5.0 ± 0.6; n = 20).

Distribution and habitat preferences.—Most specimens of *H. diyari* have been found near water bodies in the dry interior of South Australia, Queensland and New South Wales. The single female from temperate Victoria may be erroneous, as the label is not entirely conclusive (Fig. 40). While uncommon in artesian springs this species is widely distributed across most of the major spring groups within South Australia (Table 1). It is rarely found around spring vents, preferring the ephemeral wet zone that exists beyond the permanent vegetated wetland.

Hogna kuyani new species
Figs. 41–47

Types examined.—Holotype male, Australia, South Australia, Coongie Lake, 27°12′S, 140°10′E, 26.-28.x.1995, on shore, D. Hirst (SAM NN14044). Paratypes: 1 male, Coongie Lake, 27°12′S, 140°10′E, iii.1987, pitfall trap, J Reid/Coongie Lake Study (SAM NN14029); 2 females, Coongie, 4.7 km SE, 27°12′10″S, 140°11′00″E, 14 March 1987, pitfall trap, J Reid/Coongie Lake Study 11E (SAM NN14032–3).

Other material examined.—AUSTRALIA: *South Australia*: 1 ♂, Appamurna Waterhole (SAM NN14027); 1 ♂, Clayton Bore, 33 miles N of Maree (WAM T51437); 1 ♂, Clifton Hill Outstation, 1.1 km E (SAM NN14069); 3 ♂, 1 ♀, 1 juv., Clifton Hills Outstation, 4.8 km NE (SAM NN14062–5); 3 ♂, Clifton Hills Outstation, 5.4 km E (SAM NN14066–8); 1 ♂, Clifton Hills Outstation, 8 km ENE (SAM NN14070); 3 ♂, Coongie, 1.77 km W (SAM NN14041–3); 1 ♀, Coongie, 11.4 km SE (SAM NN14034); 1 ♀, Coongie, 5.3 km SE (SAM NN14030); 1 ♂, Coongie, 7.89 km N (SAM NN14037); 2 ♂, Coongie, 9.95 km NNE (SAM NN14035–6); 1 ♂, Dickinna Hill, 15.5 km SSE (SAM NN14046); 1 ♂, Dudley Park Cemetery, Adelaide (SAM NN14049); 1 ♀, Emu Bay, 4 km SE, Kangaroo Island (SAM NN14050); 1 ♂, Greenfields Wetlands, Dry Creeklisbury (SAM NN14048); 1 ♀, Lake Palankarinna (SAM NN14026); 1 ♀, Moomba, 50 km N (SAM NN14025); 2 ♂, 2 juv., Morris Creek Bore (SAM NN14021); 1 ♂, near Roxby Downs adj. Borefield Rd (SAM NN14022); 6 ♂, 1 ♀, 1 juv., New Altona Downs, 32.5 km SW (SAM NN14052–8); 1 ♂, New Altona Downs, 13 km SE (SAM NN14028); 3 ♂, 1 juv., New Altona Downs, 36 km SW (SAM NN14059–61); 1 ♀, Whyalla (MV K8248). *New South Wales*: 1 ♂, Arcoola Creek Crossing on George Loop Road, Sturt National Park (AM KS84100); 2 ♂, 5 ♀, Broken Hill (SAM NN14072–8); 1 ♂, Connia Creek, 14.8 km S of Olive Downs Homestead, via Jump-Up Loop Road, Sturt NP (AM KS71564); 4 ♂,



Figures 41–46.—*Hogna kuyani* new species: Male: 41. habitus (holotype from Coongie Lake, SA; SAM NN14044); left pedipalp: 42. ventral and 43. retrolateral view, and 44. apical part of bulb (paratype from 1.77 km W of Coongie, SA; SAM NN14041). Female from 4.8 km SE Coongie (SAM NN14031): 45. ventral and 46. dorsal view of epigynum. Scale bar: (41) 2.84 mm, (42, 43) 0.60 mm, (44) 0.32 mm, (45, 46) 0.43 mm.

Mullingar Station, Lower Murray-Darling region (AM KS67040, KS84099); 3 ♂, 1 ♀, Sturt National Park (AM KS71040); 6 ♂, 1 ♀, 1 juv., Sturt National Park, 19.2 km S of Fort Grey Homestead, on Camerons Corner Road (AM KS51348); 1 ♂, Trilby, track to New Chum, 6.4 km from highway junction. *Queensland*: 1 ♂, Baryulahl gas well, 38 km S Ballera (SAM NN14360); 1 ♂, Cluny Station Billabong (QM S61149); 1 ♂, Muncoonie Lakes (QM S61150). *Western Australia*: 3 ♂, Camel Lake Nature Reserve (WAM T47229); 2 ♂, Coolinup Nature Reserve (WAM T47232); 1 ♂, 2 ♀, Coyrecup Lake Nature Reserve (WAM T47145); 36 ♂, 7 ♀, Dumbleyung Lake North (WAM T47226, T47237); 1 ♂, Grass Patch, E of, 'Sieda', '10 bagger dam' (WAM T53586); 1 ♂, 1 ♀, Gulson Lake Nature Reserve (WAM T47218, T48084); 1 ♂, 3 ♀, Lake Bryde West Nature Reserve, Lake Bryde Rd (WAM T47138, T47225); 1 ♂, Lake Daringdella (SAM NN14051); 1 ♀, Lake Moore (WAM T47217); 2 ♀, Midland (WAM 72/248); 2 ♂, 4 ♀, 5 juv., Molpar (WAM 71/1449–54); 44 ♂, 14 ♀, 7 juv., Nugadong West Rd, SW Wubin (WAM T47137, T47228); 1 ♀, Pallarup Nature Reserve, Lake Pallarup (WAM T47231); 1 ♂, 1 ♀, Reservoir Rd, W Kodinin (WAM T47233–4); 1 ♀, 1 juv., R.G.C. Mine, 10 km S of Eneabba (WAM T51396); 13 ♂, 6 ♀, 34 juv., Taarblin Lake, 10 km SW of Toolibin Lake (WAM T51450); 21 ♂, 10 ♀, 22 juv., Taarblin Lake, south-west shore (WAM T48055–7, T48060); 1 ♂ 1 ♀, Walkaway Nature Reserve (WAM T47134, T47236); 5 ♂, Wittenoom Hill Nature Reserve, Wittenoom Rd (WAM T47230); 1 ♀, 3 juv., Yuinmery (WAM T48125).

Etymology.—The specific name is a noun in apposition honoring the Kuyani people, an Aboriginal tribe representing the traditional custodians of parts of the land on which the South Australian artesian springs are found.

Diagnosis.—*Hogna kuyani* can be distinguished from *H. crispipes* and *H. diyari* by its

uniform, dark reddish-brown carapace coloration with a dense cover of silver-grey setae and the absence of median or submarginal bands. The median septum of the female epigynum is comparatively longer than that of the other two *Hogna* species (Fig. 45). The genitalic structure of *H. kuyani* is very similar to that of *H. pexa* Hickman 1944, which differs in its considerably lighter body coloration, in particular of the abdomen. This does not seem to be an artifact of its preservation as Hickman's (1944) original description confirms a "yellow [abdomen] with a median longitudinal brown patch in anterior half" in contrast to the dark grey abdomen of *H. kuyani*.

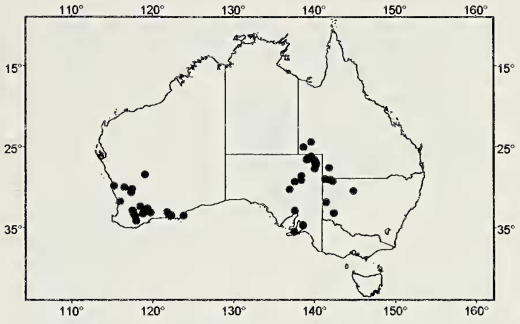


Figure 47.—Records of *Hogna kuyani* new species in Australia.

Description.—*Male:* Carapace (Fig. 41): Dark reddish-brown, with indistinct darker radial pattern; head region black; carapace covered with a thick layer of silver-grey setae (that rub off easily and may not be present in older specimens), brown bristles in head region; one long bristle between AME, four long bristles below AE. Sternum: Light brown with irregular grey pigmentation; densely covered with white setae, denser and longer towards margins. Labium: Dark brown, darkest in basal half; front end truncate and white. Chelicerae: Dark reddish-brown with a dense cover of white setae mainly in basal half; three retromarginal teeth, with the median largest; three promarginal teeth, with the median largest. Pedipalp (Figs. 42–44): Cymbium tip with ca. 6–8 macrosetae; median apophysis with ventral process that points basally; terminal apophysis sickle-shaped, embolus with a very thin tip (Figs. 42, 44). Abdomen: Dark grey-brown with an irregular pattern of dark and light spots; densely covered with silver-grey setae and fewer brown bristles in particular in anterior half; venter uniformly light brown and covered with white setae; spinnerets light brown. Legs: Leg formula IV > I > II > III; tarsi and metatarsi brown, tibiae and femora dark brown, femora with indistinct grey annulations; dense scopulous setae on all tarsi and metatarsi I and II; metatarsi I with long hair-like setae; femora, and less dense on tibiae and patellae, dorsally with dense, silver-grey setae. spination of leg I (based on holotype SAM NN14044): Femur: 6 dorsal, 2 apicoprolateral; patella: 1 prolateral, 1 retrolateral; tibia: 3 ventral pairs, 2 dorsal, 2 prolateral, 2 retrolateral; metatarsus: 2 ventral pairs, 1 apicoventral, 2 prolateral, 2 retrolateral, 1 apicoventral, 1 apicoretrolateral.

Female: Carapace, sternum, labium, and chelicerae: Coloration, setae and cheliceral dentition as male (carapace medially slightly lighter). Epigynum (Figs. 45, 46): Ventral view: Inverted T-shaped with long median septum (Fig. 45); ventral view: circular spermathecae, copulatory ducts connected posteriorly (Fig. 46). Abdomen: Coloration and setae as male. Legs: Leg formula IV > I > II > III; coloration as male; all tarsi and metatarsi I and II (only in apical half) with dense scopulae; spination of leg I (based on paratype SAM NN14032): Femur: 6 dorsal, 2 apicoprolateral; tibia: 3 ventral pairs, 1 (small) prolateral; metatarsus: 2 ventral pairs, 1 apicoventral, 1 apicoprolateral, 1 apicoretrolateral, 1 (small) prolateral.

Measurements: Male holotype SAM NN14044 (female paratype SAM NN14032): TL 11.3 (18.0), CL 6.2 (7.2), CW 4.7 (5.4). Eyes: AME 0.26 (0.29), ALE 0.17 (0.23), PME 0.63 (0.77), PLE 0.49 (0.60). Row of eyes: AE 1.17 (1.32), PME 1.63 (1.95), PLE 1.95 (2.35). Sternum (length/width) 2.9/2.0 (3.2/2.7). Labium (length/width) 0.74/0.74 (0.97/0.97). AL 5.3 (9.8), AW 3.3 (6.8). Legs: Lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): Pedipalp 2.25 + 2.25 + — + 1.95 = 6.45, I 5.25 + 7.35 + 5.25 + 2.70 = 20.55, II 4.95 + 6.30 + 4.50 + 2.55 = 18.30, III 4.50 + 5.55 + 4.80 + 2.40 = 17.25, IV 5.85 + 7.35 + 7.50 + 2.85 = 23.55 (Pedipalp 2.85 + 2.85 + — + 1.80 = 7.50, I 5.10 + 7.20 + 3.90 + 1.95 = 18.15, II 5.10 + 6.30 + 4.05 + 1.95 = 17.40, III 4.50 + 5.55 + 4.35 + 1.95 = 16.35, IV 5.70 + 7.95 + 7.50 + 2.55 = 23.70).

Variation: Males (females) (range, mean ± s.d.): TL 8.5–22.3, 15.5 ± 3.3; n = 28; CL 5.1–10.5, 8.5 ± 1.6; n = 28; CW 3.6–8.3, 6.4 ± 1.3; n = 28 (TL 12.0–19.7, 16.2 ± 2.2, n = 14; CL 5.9–9.9, 7.8 ± 1.3, n = 14; CW 4.4–7.2, 5.8 ± 0.9; n = 14).

As in *H. crispipes*, the size variation in *H. kuyani* is remarkable. For example, males range from 8.5–22.3 mm body length, meaning that the largest specimens are nearly three times the size of their smallest conspecifics.

Distribution and habitat preferences.—This species is found widely across New South Wales, South Australia, Western Australia, and Queensland (Fig. 47). It is present in low numbers across a wide range of artesian springs in South Australia, but is most common in the springs around Hermit Hill (Table 1). *Hogna kuyani* can be found in unsaturated areas of wetland vegetation, where it makes shallow, wide burrows that are concealed by sheets of web covered in mud and litter.

Unknown subfamily
Genus *Tetralycosa* Roewer 1960

Tetralycosa Roewer 1960: 949 (name first listed as *nomen nudum* in Roewer 1955: 296).

Type species.—*Lycosa meracula* Simon 1909, by monotypy (Roewer 1960).

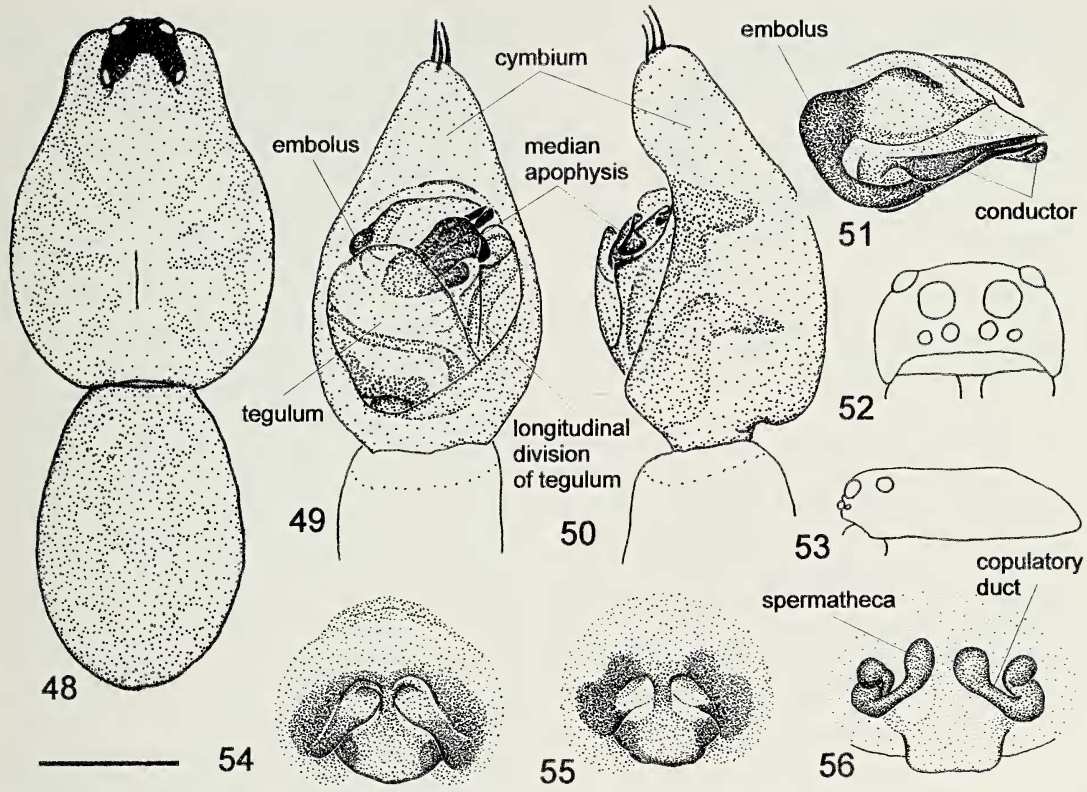
Diagnosis.—Males of *Tetralycosa* differ from all other lycosid genera by the combination of the following characters: reduced palea with well developed, thin embolus; conductor forms a shaft for the resting embolus; terminal apophysis absent; tegulum deeply divided; medium apophysis originating apically on tegulum and hook-shaped, opposing an apicomedially directed pointy protrusion on the retrolateral section of the tegulum. Females: epigynum with a wide median septum, sometimes partially hidden behind circular or oval sclerotized atrium.

Generic description.—Small to large wolf spiders (TL 4.5–22.0 mm). Males smaller than females. Carapace longer than wide, dorsal profile more or less straight in lateral view in smaller species (*T. arabanae*, *T. oraria*) (Fig. 53), but with an elevated head region and downward slope towards posterior end in larger species (*T. alteripa*, *T. eyrei*). Carapace coloration variable from a light yellowish brown (*T. arabanae*) to very dark brown (*T. eyrei*), without or with only an indistinct light median band. Abdomen coloration variable, generally with dark heart mark. AME larger than ALE, row of AE straight or slightly procurved (Figs. 52). Chelicerae generally with three promarginal and three retromarginal teeth, but 2–4 teeth on individual chelicerae possible on both margins. Leg formula IV > I > II > III or IV > II > I > III (*T. alteripa*, *T. eyrei*).

Tegulum deeply divided longitudinally in retrolateral half. Median apophysis located apically at tegulum and forming a ventrally directed hook that opposes an apicomedially directed pointy protrusion on the retrolateral section of the tegulum. Median apophysis with a basal lobe. Palea reduced. Embolus originating prolaterally on and curving ventrally around palea, long and slim. Ventrally directed lobe at the base of the embolus. Terminal apophysis well developed and forming a sclerotized shaft in which the embolus rests. Cymbium dorsally with dense, scopulous setae in apical half and without or only a few macrosetae on tip. Epigynum variable with a wide median septum sometimes only partially visible behind the sclerotized margins of the epigynum which only leave a round or oval atrium. Small round or oval spermathecae. Copulatory ducts short and twisted.

Remarks.—The monotypic genus *Tetralycosa*, with the type species *Lycosa meracula* Simon 1909, was initially listed by Roewer (1955). Subsequently, Roewer (1960) provided a diagnosis for this genus, characterized by the number of retromarginal cheliceral teeth and the arrangement of the eyes. McKay (1973) listed the species in *Lycorma* Simon 1885, following Guy (1966) who considered *Tetralycosa* a subgenus of *Lycorma*. Subsequently, McKay (1979c) synonymized *Tetralycosa* with *Lycosa*. This decision was based on the examination of two juvenile syntypes of *L. meracula*. The syntype series, however, also contains a mature male and a recent investigation of this specimen lodged at the MHNP revealed *Lycosa meracula* to be a junior synonym of *Trochosa oraria* (L. Koch 1876). Due to the unique pedipalp morphology of *T. oraria*, *Tetralycosa* is here reinstated as the valid genus and monophyletic group of Australian wolf spiders, most of which appear to favor saline conditions near salt lakes, mound springs or sea shores.

Roewer (1960) based the generic description of *Tetralycosa* mainly on somatic char-



Figures 48–56.—*Tetralycosa arabanae* new species: Holotype male from Jersey Spring, SA (SAM NN13871): 48. habitus; 49. left pedipalp, ventral; 50. left pedipalp, retrolateral; 51. male, apical part of bulb (WAM T47295, from Morris Creek Bore, SA); 52. eye arrangement; 53. lateral profile of crapace. Females: ventral view of epigynum: 54. WAM T47299; 55. WAM T47297 (from Gosse Springs, SA); 56. dorsal view of epigynum (WAM T47296, from Morris Creek Bore, SA). Scale bar: (48) 1.42 mm, (49–50) 0.35 mm (51) 0.13 mm, (52) 1.09 mm, (53) 1.49 mm, (54–56) 0.40 m.

acters, in particular the number of retromarginal teeth on the chelicerae and the arrangement of the eyes. Here, we revalidate this genus based on the unique morphology of the male pedipalp.

The subfamilial placement of *Tetralycosa* is unclear. The genus appears to have some affinities with the subfamily Pardosinae, as the conductor is "shaftlike, lying transversely along basal magin of palea" (Dondale 1986) and a "thick well-sclerotized basal part of palea concealed by tegulum" (Zyuzin 1993). However, a preliminary molecular analysis of a dataset from the 12S rRNA gene subunit, that included *T. oraria*, was not conclusive in regard to the subfamilial placement of this genus (Vink et al. 2002). Parsimony analysis resulted in the placement of *T. oraria*, together with the presumably lycosine species *Arctosa leopardus* (Sundevall 1833), as a sister-group to traditional lycosine (*Alopecosa*, *Lycosa*, *Trochosa*, *Varacosa*, *Venatrix*) and pardosine (*Pardosa*) genera combined. In contrast, a strict consensus tree of six maximum likelihood trees places *T. oraria* basally, as sister-taxon to all other lycosid species (Vink *et al.* 2002). *Tetralycosa* also shows some affinity with *Artoria*. The laminar lobe at the base of the embolus in *Tetralycosa* (Figs. 51, 58) may be homologous to the basoembolic apophysis in *Artoria*. In addition, the shaft-like conductor of *Tetralycosa* is situated similarly as the terminal apophysis (*sensu* Framenau 2002) in *Artoria*.

Four species are here included in *Tetralycosa*: *T. alteripa* (McKay 1976) new combination; *T. arabanae* new species; *T. eyrei* (Hickman 1944) new combination, and *T. oraria* (L. Koch 1876) new combination. All four species appear to be halophilic species.

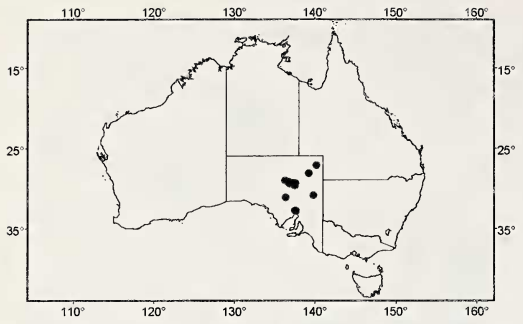


Figure 57.—Records of *Tetralycosa arabanae* new species in Australia.

Two representatives, *T. alteripa* and *T. eyrei*, are exclusively found on the surface of salt lakes in the dry interior of Australia (McKay 1976; Hudson 1996, 1997; Hudson & Adams 1996) and *T. oraria* is typically found on the foreshore and in sand dunes of ocean beaches in southern Australia and Tasmania (McKay 1979c). A full revision of this genus will be the subject of a forthcoming publication.

Tetralycosa arabanae new species
Figs. 48–57

Types examined.—Holotype male, Australia, South Australia: Jersey Spring, 29°20′S 136°45′E, 18.vii.1996, D. Niejalke (SAM NN13871). Paratypes: 1 male, 2 juveniles, same location as holotype, 18.vii.1996, D. Niejalke (SAM NN13872); 7 males, 2 females 1 female with 41 spiderlings, same location, 12.xi.1997, K-J Lamb (SAM NN13887–96).

Other material examined.—AUSTRALIA: *South Australia*: 1 ♂, Blanche Cup Mound Springs (SAM NN13884); 1 ♂, Buttercup Mound Spring (SAM NN13885); 1 ♀, Coongie Lake (SAM NN13869); 4 ♂, 1 ♀, Elizabeth Springs (North A) (SAM NN13878–82); 1 ♀, Elizabeth Springs (North B) (SAM NN13883); 1 ♀, 1 juv., Elizabeth Springs Bore (SAM NN13870); 2 ♂, 4 juv., Francis Swamp mound spring (SAM NN13876–7); 1 ♀ with 67 spiderlings, Gosse East Spring (SAM NN13886); 2 ♀, Gosse Springs (WAM T47297); 1 ♀, 1 juv., Hermit Hill Springs (SAM NN13873); 20 ♂, 10 ♀, 1 juv., Horse East Spring (SAM NN13897–916); 2 ♀, Horse Springs (WAM T47299); 1 ♀, Lake Frome (SAM NN13867); 1 ♀, Lake Hart (SAM NN13933); 1 ♀, 1 juv., Lake Hope Channel, 3.9 km S Lake Appadare (SAM NN13868); 2 ♂, 1 ♀, 1 juv., McLachlan Springs (WAM T47298); 1 ♂, 1 ♀, Morris Creek Bore (WAM T47295–6); 1 ♂, 4 juv., Old Finnis Spring (SAM NN13874); 1 ♂, Smith Spring (SAM NN13875, NN13929–32); 5 ♂, 2 ♀, 5 juv., Tregolana Salt Lake (SAM NN13862–4).

Etymology.—The specific name is a noun in apposition honoring the Arabana people, an Aboriginal tribe representing the traditional custodians of parts of the land where the South Australian artesian springs are found.

Diagnosis.—*Tetralycosa arabanae* is very similar to *T. oraria* in particular in regard to male pedipalp morphology. However, the lower tip of the conductor of the male pedipalp of *T. arabanae* has a triangular process pointing apically (Fig. 51). This process is absent in *T. oraria* (Fig. 58). Female genitalia of both species are easily distinguished as the triangular epigynum of *T. arabanae* is approximately as wide as long (Figs. 54, 55), whereas the ovoid epigynum of *T. oraria* is much wider than long (McKay, 1979c, figs. 1b, d, f).

Description.—*Male:* Carapace (Figs. 48, 53): Dorsal line straight in lateral view; light yellow-brown, sometimes with indistinct light brown radial pattern; eye field very dark brown; carapace covered with mainly white setae, few black setae posterior of fovea; few black bristles in eye field; four long brown bristles below AE, one long bristle between AME. Sternum: Yellow; white setae and fewer brown bristles both denser and longer towards margins. Labium: Brown; front end truncate and white. Chelicerae: Light brown; white setae basally and laterally, black setae apically near fangs; two retromarginal teeth of similar size; three promarginal teeth, with the median largest. Pedipalp (Figs. 49–51): Median apophysis a broad, ventrally directed hook and with basal lobe; embolus with a basal bulge and resting in a shaft formed by the conductor; lower tip of conductor triangular (Fig. 51); cymbium dorsally with scopulous setae in apical half, and few apical macrosetae. Abdomen: Olive-yellow; faint brownish heart mark in anterior half; three to four pairs of yellow spots, of which the anterior and posterior pair are largest; covered with white setae and few longer, brown bristles; venter yellow; setae as dorsally, but brown bristles lighter and shorter; spinnerets yellow. Legs: Leg formula IV > I > II > III; light yellow-brown, with faint annulations centrally and in

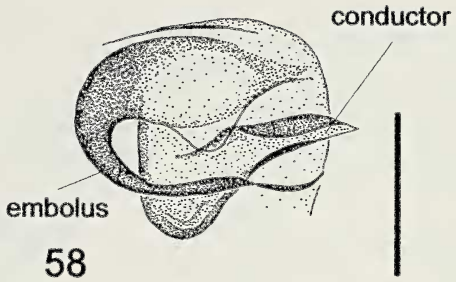
apical half of femora, in basal half of patella, and basally and centrally on tibia; tarsus and metatarsus of legs I and II darker (brown); spination of leg I (based on holotype SAM NN13871): Femur: 4 dorsal, 1 apicoprolateral, 1 apicoretrolateral; patella: 1 prolateral, 1 retrolateral; tibia: 3 ventral pairs, 2 dorsal, 2 prolateral, 2 retrolateral; metatarsus: 3 ventral pairs, 3 prolateral, 3 retrolateral; 1 apicoventral.

Female: Carapace, sternum and labium: as male. Chelicerae: Dark brown, generally much darker than in males; setae and bristles as male; cheliceral dentition as male. Epigynum (Figs. 54–56): Ventral view: triangular with convex posterior margin (Figs. 54, 55); dorsal view: small oval spermathecae, copulatory ducts directed anteromedially, small spermathecal organs (Fig. 56). Abdomen: As male. Legs: Leg formula IV > I > II > III; coloration as male, however tarsus and metatarsus of leg I and II not darker; spination of leg I (based on female SAM NN1389, reduced in comparison to males): Femur: 4 dorsal, 1 apicoprolateral; tibia: 1 apicoventral pair, 1 prolateral; metatarsus: 2 ventral pairs, 1 apicoventral.

Measurements: male holotype SAM NN13871 (female SAM NN13894): TL 7.3 (7.6), CL 4.0 (3.7), CW 2.8 (2.7). Eyes: AME 0.2 (0.2), ALE 0.14 (0.16), PME 0.28 (0.32), PLE 0.26 (0.16). Row of eyes: AE 0.82 (0.88), PME 0.76 (0.80), PLE 1.10 (1.20). Sternum (length/width) 2.0/1.5 (1.6/1.4). Labium (length/width) 0.51/0.52 (0.54/0.66). AL 3.1 (3.4), AW 2.3 (2.6). Legs: Lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): Pedipalp 1.50 + 1.25 + — + 1.20 = 3.95, I 3.05 + 3.90 + 2.90 + 1.55 = 11.40, II 3.0 + 3.65 + 3.0 + 1.5 = 11.15, III 2.85 + 3.25 + 3.05 + 1.4 = 10.55, IV 3.55 + 4.20 + 4.0 + 1.8 = 13.55 (Pedipalp 1.25 + 1.25 + — + 1.0 = 3.5, I 2.35 + 3.15 + 1.95 + 1.1 = 8.65, II 2.30 + 2.90 + 1.9 + 1.05 = 8.15, III 2.25 + 2.25 + 2.05 + 1.05 = 7.9, IV 2.9 + 3.4 + 3.1 + 1.30 = 10.7).

Variation: males (females) (range, mean ± s.d.): TL 4.8–7.7, 6.3 ± 0.8; n = 23; CL 2.5–4.2, 3.3 ± 0.5; n = 24; CW 2.0–3.2, 2.5 ± 0.3; n = 24 (TL 6.6–11.1, 7.9 ± 1.2, n = 17; CL 3.1–5.8, 3.8 ± 0.6, n = 19; CW 2.2–3.6, 2.7 ± 0.4; n = 19).

Distribution and habitat preferences.—This species is restricted to arid South Australia (Fig. 57). It is found in the southern and eastern springs from Jersey Springs in the west to Mulligan Springs in the east (Table 1). *Tetralycosa arabanae* is largely restricted to the lower parts of the spring tail and the ephemeral wet regions beyond the permanent vegetated wetland. It has also been found near semi-permanent saline waterholes near Hermit Hill Springs.



Figures 58.—*Tetralycosa oraria* (L. Koch 1876): Male from Australind, WA (WAM 71/360), apical part of bulb. Scale bar: 0.21 mm.

NON-ARTESIAN SPRING LYCOSIDAE OF THE GENUS *TETRALYCOSA*

The following species are not part of the artesian spring fauna of South Australia, but are transferred to the *Tetralycosa* as they show the unique pedipalp morphology characteristic for this genus.

Tetralycosa alteripa (McKay 1976) new combination

Lycosa alteripa McKay 1976: 418–420, figs. 2, 2a–e; Brignoli 1983: 450; McKay 1985: 74.

Remarks.—*Tetralycosa alteripa* shows the typical pedipalp and epigynum structure of *Tetralycosa* (McKay 1976, 418–420, figs. 2, 2a–e; holotype male (WAM 70/41) and paratype males and females (WAM 70/42–46, 74/501) examined by VWF) and is therefore transferred from the northern hemisphere genus *Lycosa* to *Tetralycosa*. This species is typically found on the surface of salt lakes in South Australia and Western Australia (McKay 1976; Hudson 1997). An allozyme study suggests the existence of an undescribed, cryptic sister-species of *T. alteripa* in Western Australia (Hudson & Adams 1996).

Tetralycosa eyrei (Hickman 1944) new combination

Pardosa eyrei Hickman 1944: 24,25, plate 1, figs. 11–13; Roewer 1955: 185; McKay 1973: 378.
Lycosa eyrei (Hickman 1944): McKay 1985: 76; Platnick 1989: 370.

Remarks.—The pedipalp and epigynum structure of *T. eyri* is similar to that of *T. alteripa* (Hickman 1944: 24, 25, plate 1, figs. 11–13; holotype male (AM KS5738) and conspecific males and females (SAM NN13809–15, NN17384–5; MV K8126, K 8183, examined by VWF). As in *T. alteripa*, this species is typically found on the surface of salt lakes in South Australia and Victoria (Hudson 1996; Hudson & Adams 1996), although, allozyme data suggest the co-occurance of two cryptic species within *T. eyrei* (Hudson & Adams 1996). *Tetralycosa eyrei* has a sympatric distribution with the salt-lake dwelling scorpion *Australobuthus xerolimniorum* Locket 1990 (Hudson 1997).

Tetralycosa oraria (L. Koch 1876) new combination
Fig. 58

Lycosa oraria L. Koch 1876: 883–886, plate 76, figs. 2, 2a, 3, 3a; Simon 1909: 188; Rainbow 1911: 270; Bonnet 1957: 2656.
Lycosa candicans L. Koch 1877: 888–890, plate 76, figs. 5, 5a, 6, 6a, b; Rainbow 1911: 266; Hickman 1950: 5; Bonnet 1957: 2637. NEW SYNONYMY.
Lycosa sibyllina Simon 1909: 188, 189, fig. 7; Rainbow 1911: 272; Bonnet 1957: 2664; McKay 1973: 379; Moritz 1992: 325. Synonymized by McKay 1979c: 279.
Lycosa meracula Simon 1909: 190, 191; Rainbow 1911: 270; McKay 1985: 80; Platnick 1989: 372; Moritz 1992: 320. NEW SYNONYMY.
not *Lycosa meracula* Simon, *sensu* McKay 1979c: 264, figs. 9a–k (misidentification; not *L. meracula* but an undescribed species).
Crocodilosa oraria (L. Koch 1877): Roewer 1955: 238.
Tetralycosa meracula (Simon 1909): Roewer 1955: 296; Roewer 1960: 949; Rack 1961: 38.
Hogna sibyllina (Simon 1909): Roewer 1955: 253.
Trochosula candicans (L. Koch 1877): Roewer 1955: 304.
Trochosomma oraria (L. Koch 1877): Roewer 1960: 847; Roewer 1961: 14.
Ocyale oraria (L. Koch 1877): McKay 1973: 380.
Lycorma meracula (Simon 1877): McKay 1973: 380.
Trochosa candicans (L. Koch 1877): McKay 1973: 381; McKay 1979c: 293–294, fig. 4e; McKay 1985: 85; Platnick 1989: 390.
Trochosa oraria (L. Koch 1877): McKay 1979c: 279–282, figs. 1a–h; McKay 1985: 86; Platnick 1989: 391; Platnick 1993: 510.

Remarks.—The male pedipalp of *T. oraria* is very similar to that of *T. arabanae*. It can mainly be distinguished by the lower tip of the conductor, which has a triangular protrusion in *T. arabanae* (Figs. 51), but not so in *T. oraria* (Figs. 58). The wide, oval median septum of the epigynum of *T. oraria* (McKay 1979c: 279–282, figs. 1b, d, f) conforms to the general pattern of *Tetralycosa*.

Simon (1909) described *Lycosa meracula* based on one male and some immature spiders from (p. 191) "Stat. 5, Denham, *ad litus in detritus*; Stat. 65, Albany" collected during the 'Hamburger Südwest-Australische Expedition 1905' (Michaelsen & Hartmeyer 1907; Simon 1909). Three immatures from Denham are deposited in Hamburg (ZMH, Rack (1961)-catalogue 466), Berlin (ZMB 11085) and Perth (WAM 11/4303) (VWF, all examined). Therefore, the adult male lodged in Paris (MHNP 24964, labeled "*Lycosa meracula* E.S., Austr. occid. (Michaelsen)", VWF, examined) without accurate locality data must be regarded as the syntype from Albany. This adult male is conspecific with *T. oraria* L. Koch 1876, as there is no difference in somatic and genitalic characters between these species. Consequently, *L. meracula*, the type species of *Tetralycosa*, is considered a junior synonym of *T. oraria*. This also agrees with the type localities of both species, as *T. oraria* was described from King George Sound, the harbor bay of Albany (L. Koch 1876).

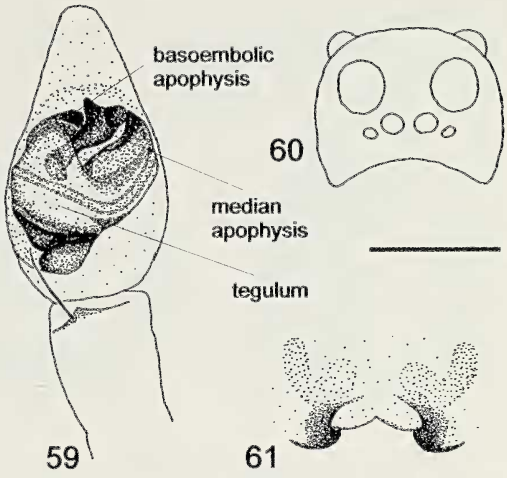
Not being aware of the existence of the mature male syntype at the MHNP, McKay (1979a) redescribed *T. meracula* based on adult material collected near the type locality, Denham, of the immature specimens which are lodged in Berlin and Perth. However, the species he illustrated is not conspecific with the adult male syntype of *T. meracula* from Albany, and therefore his treatment of this species must be regarded as erroneous. He also stated that (p. 267) "The record of this species from Albany [. . .] is erroneous, as the southern limit of this species appears to be just north of the Murchison River. [. . .] Station 65 'Albany' refers to station 65 Denham

[. . .] and not station 165 Albany." Although Simon (1909) was incorrect citing "Stat. 5" for Denham (actually Stat. 65; Stat. 5 refers to a marine surface collection near Denham) and "Stat. 65" for Albany (actually Stat. 165), McKay's (1979a) redesignation of the type locality for the male syntype from Albany to Denham appears to be incorrect. Simon's (1909) "Stat. 65, Albany" is most likely a transcription error of "Stat. 165, Albany".

It is likely that the immature syntypes of *L. meracula* are not, as McKay (1979a) suspected, conspecific with the adult male from Albany, as *T. oraria* has not been reported from as far north as Denham. However, the adult male remains the name-bearing specimen as it was described earlier (Simon 1909, pp. 190, 191) than the juveniles (p. 191) (recommendation 69A.10, ICZN 1999). More importantly, only the male syntype of *L. meracula* allows for an accurate identification of this species.

The original illustrations of *T. candicans* (L. Koch 1877) with the hook-shaped median apophysis of the male pedipalp and the oval epigynum strongly suggest a synonymy with *T. oraria*. McKay (1979c) also stressed the similarity of *T. oraria* and *T. candicans* but did not synonymize both species, as he was not able to investigate more than one female specimen (listed as *T. candicans* in Hickman (1950)) of this presumably eastern Australian species. *Tetralycosa oraria* was then only known from Western Australia. A comparison of type material of both species is not possible as no syntypes of *L. candicans* could be located in the Naturhistorisches Museum, Vienna (J. Gruber, personal communication) or 'Bradleys Collection' (whereabouts of this collection unknown) where, according to L. Koch (1877), they should be housed. Our recent investigations uncovered a large number of recently collected *T. oraria* in the AM, MV, SAM, TMAG, and QVMAG from eastern Australian states including Tasmania which leave no doubt that *T. candicans* and *T. oraria* are conspecific. Therefore, *T. candicans* is considered a junior synonym of *T. oraria*.

Tetralycosa oraria is mainly found on beaches and sand dunes along the southern coast of mainland Australia (Vic, SA, NSW, WA) and Tasmania.



Figures 59–61.—*Artoria howquaensis* Framenau 2002: Male from Howqua River, Vic (MV K7467): 59. left pedipalp, ventral; 60. eye arrangement. Female from from Howqua River, Vic (MV K7468): 61. dorsal view of epigynum Scale bar: (59) 0.30 mm, (60) 0.82 mm, (61) 0.30 mm.

Genus *Artoria* Thorell 1877

Artoria Thorell 1877: 531.
Artoriella Roewer 1960: 563 (name listed as *nomen nudum* in Roewer 1955: 233).
Trabaeola Roewer 1960: 582.

Remarks.—The genus *Artoria* Thorell was established with the description of the male of *A. parvula* Thorell 1877 from Sulawesi. Framenau (2002) reviewed the genus including the description of seven new species from floodplain habitats in Victoria. An alpine *Artoria* was recently recorded from Mt. Kosciusko (NSW) (Framenau 2004). The genus appears to be widespread in southeast Asia and the Australasian region with probably more than 50 undescribed species in Australia alone (Framenau 2002). Vink (2002) recently recorded three new species from New Zealand. The palpal morphology of *Artoria* is unique within the Lycosidae, and a preliminary molecular analysis suggests that this genus forms a monophyletic clade with *Anoteropsis* Koch, 1877 and *Notocosa* Vink 2002 (Vink et al. 2002). *Artoria* does not fit any of the current subfamilies defined by Dondale (1986), Alderweireldt and Jocqué (1993) or Zyuzin (1985, 1993).

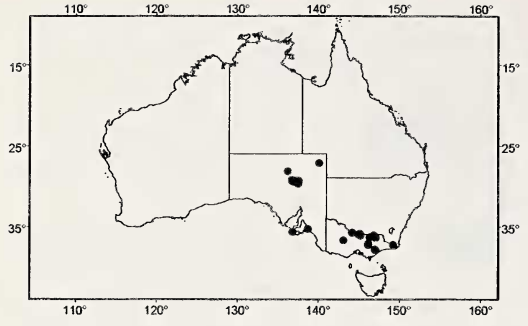


Figure 62.—Records of *Artoria howquaensis* Framenau 2002 in Australia.

Artoria howquaensis Framenau 2002
Figs. 59–61

Artoria howquaensis Framenau 2002: 217, 218, figs 9a–g, 10.

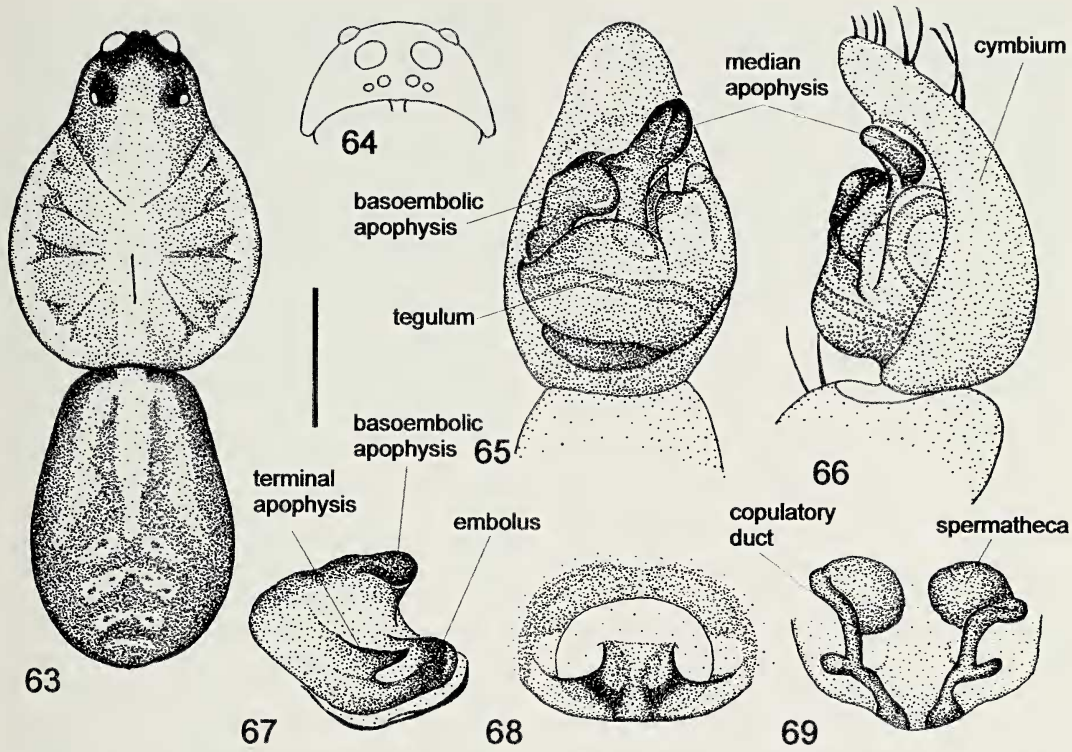
Diagnosis.—This is the smallest (TL 3.5–6 mm) and one of the most common wolf spiders at the South Australian artesian springs. It can easily be distinguished by its body coloration. The carapace is black, with distinct white marginal bands caused by a dense layer of white setae. The abdomen is dark grey to black, an indistinct lighter heart mark may be visible. The patella and tibia of the first leg of males are bright yellow. The tibia and basal half of the cymbium of the male pedipalp bear a dense cover of white setae. The median apophysis of the male pedipalp bears an apical triangular lobe (Fig. 59). The female epigynum is a simple, laterally sclerotized posterior atrium (Fig. 61).

Distribution and habitat preferences.—In addition to being widespread and common within the South Australian artesian springs (Table 1), this species has been found in lowland floodplains of rivers and other moist habitats in Victoria and South Australia, including Kangaroo Island (Framenau 2002; D. Hirst, pers. comm.) (Fig. 62). Within the artesian springs, *Artoria howquaensis* prefers *C. laevigatus* wetlands and can be found foraging on top of dense mats of vegetation. It is active mainly during the day and retreats to a silk shelter at the base of *C. laevigatus* during the night.

Artoria victoriensis new species
Figs. 63–70

Types examined.—Holotype male Australia, Victoria: Melbourne, 37°49′S, 144°58′E, 8 October 1956, A Neboiss (MV K7742). Paratype female, Kilsyth, 37°48′S 145°19′E, 11 October 1981, on fence, ME Roberts (MV K7741).

Other material examined.—AUSTRALIA: *South Australia*: 1 ♂, 1 ♀, 1 ♀ with eggsac, 4 juv., Adelaide foothills nr. Waite Campus (SAM NN13113–15); 1 ♀, 1 juv., Adelaide Parklands between Adelaide Zoo and Hackney Bridge (SAM NN13132); 4 ♂, 4 ♀, Belair (SAM NN13094–101); 1 ♀, Bolivar (SAM NN13139); 1 ♂, 3 ♀, Bridgewater, Mt Lofty Ranges (SAM NN13086–9); 1 ♀, Calpatanna Waterhole Conservation Park, Wedina Well (SAM NN13163); 2 ♂, 1 ♀, Cape St Albans Lighthouse, 5.25 km WNW, Kangaroo Island (SAM NN13068–70); 1 ♀, Carrieton Township, E side (SAM NN13161); 8 ♂, 4 ♀, 1 juv., Francis Swamp, mound spring near Leonard Bore (SAM NN1236–47); 1 ♀, Ceres, Furner (SAM NN13042); 1 ♂, Charleston Conservation Park (SAM NN13112); 2 ♂, 4 ♀, 2 juv., Chowilla, Nil Nil Bend (SAM NN617–9, NN13157–9); 2 ♂, 7 ♀, Cleland Conservation Park, cnr Wine Shanty & Pit Box tracks (SAM NN13102–11); 3 ♀, Conmurra, 4.4 km N telephone exchange (SAM NN13036–8); 1 ♂, Coorong area, 5 km ENE Tilley Swamp telephone exchange (SAM NN13047); 3 ♂, Coorong area, 1.5 km ENE Tilley Swamp telephone exchange (SAM NN13048–50); 3 ♂, Coromandel Valley (SAM NN1309–2); 1 ♂, Cox Scrub Conservation Park, 2 km S South tip (SAM NN13083); 1 ♀, Custon, 1.2 km S (SAM NN13056); 1 ♀, Flinders Ranges National Park, 1.7 km SW Wilpena Chalet (SAM NN13160); 2 ♀, Frances, 1.1 km NNE (SAM NN13054–5); 1 ♀ with eggsac, Greenfield Wetlands, Salisbury (SAM NN13140); 1 ♂, Inglewood Homestead, 1.3 km SSE (SAM NN13065); 1 ♀, King Fisher Spring, Dalhousie Springs (SAM); 1 ♀ with eggsac, Klemzig (SAM NN13131); 1 ♀, Kongorong Forest Reserve, 16.4 km WNN Headquarter (SAM NN13026); 1 ♀, Kongorong Forest Reserve, 17.3 km WNN Headquarter (SAM NN13025); 14 ♀, 1 juv., Kongorong, 14.5 km W telephone exchange (SAM NN13011–24); 1 ♀, Lake Malata South (SAM NN13162); 2 ♂, 4 ♀, Largs North (SAM NN13133–8); 1 ♂, Lucindale (SAM NN13043); 1 ♂, 1 ♀, 1 juv., Magill CAE, Adelaide (SAM NN13126–7); 1 ♂, 1 ♀, Magrath Flat, 9 km NW (SAM



Figures 63–69.—*Artoria victoriensis* new species: Male holotype from Melbourne, Vic (MV K7742): 63. habitus; 64. eye arrangement; 65. left pedipalp, ventral; 66. left pedipalp, retrolateral; 67. apical part of bulb (MV K7774, from near Baxter, Vic). Female: 68. ventral view of epigynum (MV 7741, from Kilsyth, Vic); 69. dorsal view of epigynum (MV 7740, from Yarra Valley Park, Vic). Scale bar: (63) 1.18 mm, (64) 1.01 mm, (65, 66) 0.38 mm, (67) 0.27 mm, (68, 69) 0.33 mm.

NN13148–9); 1 ♂, Melville Gully, Belair National Park (SAM NN13093); 1 ♀, Millewa Road, NE Hahndorf (SAM NN13085); 2 ♀, 1 juv., Millicent Airport, 11 km SW (SAM NN13027–8); 1 ♀, Millicent Airport, 14 km SW (SAM NN13029); 3 ♀, Minecrow trip point, NNE (SAM NN13044–6); 4 ♀, 2 ♀ with spiderlings, Mitcham (SAM NN13116–21); 12 ♀, Monarto Zoo (SAM NN14200–11); 1 ♀, Mt Benson telephone exchange, 8.7 km ENE (SAM NN13039); 1 ♂, 2 juv., Mt Compass, 21 km ESE (SAM NN13080); 1 ♀, Mt Compass, 22 km ESE (SAM NN13082); 1 ♂, Mt Compass, 9 km E (SAM NN13081); 3 ♂, Mt Rough, 12.1 km NNE (SAM NN13051–3); 1 ♂, Muston, Kangaroo Island (SAM NN13067); 1 ♂, 1 juv., Muston, Kangaroo Island, in midchannel of Pelican Lagoon (SAM NN13066); 2 ♀, Myponga, Mt Lofty Ranges (SAM NN13154–5); 1 ♀, Nappyalla (SAM NN13146); 1 ♂, 1 juv., nr. Pyap (SAM NN13151); 1 ♀, 1 juv., Old Kings Station, 2 km W (SAM NN13147); 1 ♂, Parawa, 2 km WNW (SAM NN13078–9); 5 ♂, 1 ♀, Parawa, 5 km ENE (SAM NN13072–77); 1 ♀, Penola Forest Reserve, 19.7 km NW Headquarter (SAM NN13030); 5 ♀, 1 juv., Penola Forest Reserve, 5 km NNE Headquarters (SAM NN13031–5); 1 ♀, Point Sturt, Lake Alexandrina (SAM NN13150); 1 ♂, Pooginagorie, 3.7 km NE (SAM NN13057); 2 ♀, 1 juv., Pyap, 2 km S (SAM NN13152–3); 2 ♀, Robe substation, 5.3 km S (SAM NN13040–1); 1 ♂, Scott Creek Conservation Park, MacKreath Creek (SAM NN13084); 5 ♂, Scott Creek, S of Morgan, near River Murray (SAM NN13141–5); 1 ♀, Tarkeerip, 6.1 km NE (SAM NN13064); 3 ♂, 3 ♀, Teatrick, 0.4 km WSW (SAM NN13058–63); 1 ♂, Tindale East Cave (AM KS52385); 1 ♀ with eggsac, Torrens Park, Magill CAE (SAM NN13122); 1 ♀, Torrens Park (SAM NN13123); 1 ♀, 1 ♀ with eggsac, Tusmore (SAM NN13124–5); 1 ♂, Victor Harbor (SAM NN13071); 3 ♂, Windsor Gardens (SAM NN13128–30). *New South Wales*: 30 ♂, 28 ♀, 1 juv., Coleambally

irrigation area (AM KS58090, KS58127, KS58164, KS58183, KS58235, KS58311, KS67076, KS67152, KS67342, KS67348, KS67354, KS67412, KS67506, KS67674, KS67678, KS67684, KS68649, KS68654, KS68662, KS67764, KS71271); 2 ♂, Crown residency, corner of New England Highway and Old Tamworth Road (AM KS82846, KS82854); 1 ♂, 2 ♀, Gilgandra, 39 km NNW, turnoff to Warrumbungles National Park (AM KS76597–8, KS76600); 1 ♀, Gin Gin, 2.5 km NW, on road to Riverview Station (AM KS76601); 1 ♂, Kwiambal National Park, East side, 150m South of Road (AM KS82858); 1 ♂, 1 ♀, McIntyre River, 2.8 km S of Boggabilla on Bruxner Highway (AM KS76603, KS76605); 1 ♀, Moree (AM KS32588); 1 ♂, 6 ♀, Wambianna Station, 7.5 km NW Gin Gin (AM KS76599, KS76602, KS76604, KS76606, KS76704); 1 ♀, Weemelah, S of, 150m North of bridge over Gingham Watercourse (AM KS76706). TASMANIA: 1 ♀, Bird Island, George Rocks (QVMAG 13:44297); 1 ♀, 1 ♀ with eggsac, Launceston (QVMAG 13:42995–6); 2 ♀ with eggsac, Launceston, 43 High St (QVMAG 13:44298); 1 ♀ with spiderlings, Launceston, Kings Meadows (QVMAG 13:42070); 1 ♂, Mt Chapell Island, Bass Strait (QVMAG 13:44299); 1 ♂, Waterhouse, South Croppies Point (QVMAG 13:43254). *Victoria*: 1 ♀, no exact location, 1923 (MV K7654); 1 ♀, no exact location ('Teacher's Training College') (MV K7649); 4 ♂, 3 ♀, Barmah Forest (WAM T53795, T55467); 1 ♂, near Baxter (MV K7774); 4 ♂, 4 ♀, Bendigo, LaTrobe University (CVIC); 1 ♀, 1 juv., Bendigo (MV K7658); 1 ♂, 2 ♀, 1 juv., Camberwell (MV K7653); 16 ♂, 4 ♀, Cohuna, Kervins Rd, Barr Ck (MV K8116); 2 ♀, 2 juv., Dalyenong Flora Reserve, Plantation Tk, 900 m S Gum Flat Tk (MV K9247, K9249); 2 ♀, 6 juv., Deep Ck, 7 km SSE Barmah (MV K8724); 1 ♂, 1 ♀, 2 juv., Deep Lead Flora Reserve, Deep Lead Rd, 800 m NE of Western Hwy (MV K9226); 1 ♂, 1 ♀, 3 juv., Deep Lead Flora Reserve, 800 m SW Garnard Park/Deep Lead Rd along Deep Lead Rd (MV K9045, K9232); 1 ♂, 1 ♀, 1 ♀ with spiderlings, 11 juv., Deep Ck, 7 km SSE Barmah (MV K8719, K9057); 2 ♂, East St Kilda (MV K7650); 3 ♀, Eynesbury Estate, Werribee (MV K9111, K9116, K9143); 1 ♀, Glen Waverley (MV K7651); 2 ♂, 1 juv., Glen Waverley, Watsons Rd (MV K7735); 4 ♀, Goulburn River, 12 km SSE Nathalia (MV K9029, K9041); 3 ♂, 1 ♀, Graytown, 200 m N of Heathcote/Nagambie Rd, 80 m W on drive to abandoned house (MV K9238, K9262); 1 ♀, Hamilton (MV K7657); 2 ♀, Kilsyth, 38 Mountfield Rd (MV K7644–5); 1 ♀ with spiderlings, 1 ♀ with 16 spiderlings, 2 juveniles, Kotupna Barmah Rd at Ellingtons Bridge (MV K8748, K9053); 1 ♀, 1 juv., Lerderderg Gorge, 9 km NNW of Bacchus Marsh (MV K7655); 6 ♂, 1 ♀, 2 juv., Maldon State Forest, 1.7 km along Red White and Blue Tk from Pullens Rd (MV K9246, K9250, K9253); 1 ♀ with spiderlings, Melbourne, in museum (MV K7656); 1 ♀, Merbein (AM KS32465); 1 ♂, Mitchell Link Tk, 200 m W Mitchell Tk (MV K9219); 1 ♀, Morrisons (MV K7648); 1 ♀, Murray Valley Hwy, Deep Ck Crossing (MV8775); 9 ♂, 6 ♀, 5 juv., Mt Bolangum Forest Reserve, 5.7 km N Andersons Rd, then 200 m on minor Tk (MV K9209, K9229, K9233); 1 ♂, Mt Ida Flora Reserve, 2.3 km NW along Rodney Tk from Dargie Tk (MV K9244); 1 ♀, Nangiloc (AM KS86408); 1 ♀, Natimuk (MV K7646); 1 ♀ with spiderlings, North Melbourne (MV K7647); 2 ♂, 2 ♀, Point Cook (MV K9113–4, K9135); 1 ♂, 1 ♀, Point Cook, opposite carpark 1 (MV K9106, K9108); 1 ♀, Point Cook, 100 m E of Recreation Beach area (MV K9109); 1 ♀, Point Cook, lower sanddune (MV K9112); 2 ♀, Point Cook, lower edge (MV K9115); 6 ♂, 6 ♀, 10 juv., Pomfrets Rd, 0.6 km S Picola-Katunga Rd (MV K8767, K9034, K9050); 7 ♂, 4 ♀, Potter Creek, 1.7 km S of Western Highway (MV K7652); 3 ♀, Rathbones Rd, 3.0 km E Booths Rd (MV K8727, K8746); 3 ♂, 5 juv., Reedy Lake Wildlife Reserve, 600 m W Goreys Rd along Reedy Lake Rd (MV K9259); 1 ♂, 1 juv., Reedy Lake Wildlife Reserve, 2.1 km S along Reedy Lake Rd from Davies Rd (MV K9297); 1 ♀, 1 ♀ with eggsac, Spring Gully (CVIC); 2 ♀, State Forest, 3.5 km NE Yambuna (MV K8708, 8759); 1 ♂, Upper Lurg (CVIC JSt104); 1 ♀, Werribee morticain Saltmarsh (MV K9110); 2 ♀, Werribee Treatment farm (MV K9117); 1 ♀ with eggsac, West Brunswick (MV K8119); 1 ♂, Western Railway Rd (MV K9133); 2 ♀, Williamstown (MV K9107); 2 ♀, Yarra Valley Park (MV K7740).

Etymology.—The species name is an adjective in apposition and refers to the Australian state Victoria, which represents the center

of the distribution and the state where the holotype was found.

Diagnosis.—Males of *A. victoriensis* can be distinguished from all other Australian *Artoria* by the unique shape of the median apophysis that resembles an upside-down sock in ventral view. The female epigynum is uniquely oval-shaped, with a white center and a sclerotized posterior rim reaching medially into this center.

Description.—*Male:* Carapace (Fig. 63): Brown, with distinct light brown median and submarginal bands; head region black; dark grey radial pattern; carapace covered with white setae, particularly dense in median and submarginal bands and between PE; four brown bristles in median band anteriorly of fovea; two rows of black bristles between PME; few black bristles posterolateral of PME. Sternum: Light brown with dense, dark grey pigmentation; sparsely covered with brown bristles mainly towards margins and frontal border. Labium: Brown; front end truncate and white. Chelicerae: Uniformly brown; covered with long white setae and few brown bristles; three retromarginal teeth, with the median largest; three promarginal teeth, with the basal smallest. Pedipalp (Figs. 65–67): Cymbium tip with approx. eight macrosetae; median apophysis shaped like an upside-down sock in ventral view; embolus stout and blunt, terminal apophysis a pointy hook (Fig. 67). Abdomen: Dark grey; yellowish-brown lanceolate heart mark in anterior half; irregular yellow patches lateral of heart mark; three yellow chevrons in posterior half; covered with white setae and few longer, brown bristles; venter yellow-brown with irregular dark grey patches; covered with white and fewer brown setae; anterior spinnerets black, posterior spinnerets yellow-brown. Legs: Leg formula IV > I > III > II; light brown, with distinct dark grey annulation which is in particular distinct on lighter ventral side of legs; spination of leg I (based on holotype MV K7742): Femur: 3 dorsal, 1 apicoprolateral; tibia: 3 ventral pairs, 2 prolateral; metatarsus: 3 ventral pairs, 2 prolateral, 1 apicoventral, 1 apicoretrolateral.

Female: Carapace: As male, more brown bristles in median band anteriorly of fovea. Sternum: Yellowish-brown with dense, dark grey pigmentation; sparsely covered with long brown bristles and few brown setae. Labium: as male. Chelicerae: Uniformly dark brown; covered with long white setae and few brown bristles; dentition as male. Epigynum (Figs. 68–69): Ventral view: oval shaped, wide sclerotization reaching from posterior margin into center (Fig. 68); dorsal view: large oval spermathecae, copulatory ducts connected laterally; small spermathecal organs (Fig. 69). Abdomen: As male, light pattern less distinct; venter yellow-brown few dark grey patches in particular posterior of epigastric furrow; covered with white and fewer brown setae; all spinnerets light brown. Legs: Leg formula IV > I > III > II; coloration as male, annulations less distinct; spination of leg I (based on paratype MV K7741): Femur: 3 dorsal, 1 apicoprolateral; tibia: 3 ventral pairs, 1 prolateral; metatarsus: 3 ventral pairs, 3 prolateral, 1 apicoventral.

Measurements: Male holotype MV K7742 (female paratype MV K7741): TL 5.55 (6.5), CL 3.0 (3.0), CW 2.2 (2.2). Eyes: AME 0.08 (0.10), ALE 0.08 (0.09), PME 0.30 (0.30), PLE 0.20 (0.22). Row of eyes: AE 0.50 (0.54), PME 0.76 (0.80), PLE 0.98 (1.00). Sternum (length/width) 1.40/1.20 (1.45/1.2). Labium (length/width) 0.42/0.4 (0.44/0.42). AL 2.4 (3.1), AW 1.9 (2.1). Legs: Lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): Pedipalp 1.05 + 1.05 + — + 1.05 = 3.15, I 1.75 + 2.45 + 1.55 + 0.85 = 6.60, II 1.7 + 2.15 + 1.30 + 0.7 =.5.85, III 1.6 + 2.0 + 1.6 + 0.7 =.5.9, IV 2.1 + 2.75 + 2.4 + 1.0 = 8.25 (Pedipalp 1.05 + 1.0 + — + 0.75 = 2.8, I 1.8 + 2.35 + 1.3 + 0.75 = 6.2, II 1.7 + 2.15 + 1.2 + 0.75 = 5.8, III 1.65 + 1.85 + 1.5 + 0.7 = 5.9, IV 2.2 + 2.75 + 2.45 + 0.95 = 8.35).

Variation: Males (females) (range, mean ± s.d.): TL 3.5–6.3, 4.6 ± 1.0; n =10; CL 1.9–3.3, 2.6 ± 0.5; n =11; CW 1.4–2.3, 1.9 ± 0.3; n =11 (TL 5.2–8.4, 6.4 ± 0.7, n = 19; CL 2.2–3.6, 3.0 ± 0.4, n =20; CW 1.6–2.8, 2.2 ± 0.3; n =20).

Distribution and habitat preferences.—This species is most common in temperate Victoria, South Australia and New South Wales (Fig. 70), where it can typically be found in open, moderately moist habitats. It is also common in suburban Adelaide and Melbourne. Within the South Australian artesian springs, *A. victoriensis* has been found at Kingfisher Springs in the Dalhousie Springs complex and at Big Depot Springs in the Francis Swamp complex (Table 1), where it

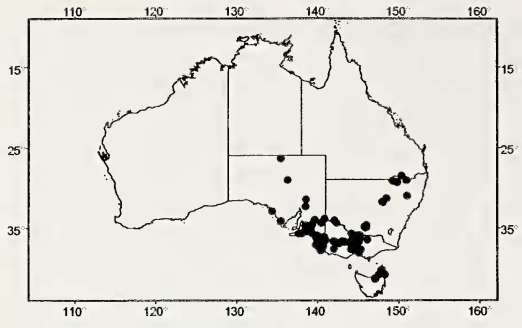


Figure 70.—Records of *Artoria victoriensis* new species in Australia.

inhabits low open vegetation on saturated substrates.

Remarks.—It is possible that the artesian springs populations were established by human introduction as this species is most common in highly populated suburban regions in South East Australia and has been found at artesian springs that are frequented by tourists. Females with eggsac or spiderlings have been found mainly in November and December, but also in September, February, and March.

DISCUSSION

The wolf spider fauna at South Australian artesian springs comprises a number of wetland dependent species that have broad distributions, as well as others that appear to be more closely associated with the springs. Of the nine lycosids recorded during this study, seven occur in other Australian and overseas wetland habitats, such as river floodplains and lake shores (*A. howquaensis*, *A. victoriensis*, *H. crispipes*, *H. diyari*, *H. kuyani*, *V. arenaris*, and *V. goyderi*). In contrast, *V. fontis* and *T. arabanae* appear to be largely restricted to artesian springs and have only rarely been found in other wetland habitats.

The biology and habitat preferences of the artesian spring species are poorly understood. *Venatrix goyderi* and *H. crispipes* are mostly found at bore drains and it is possible that these species are recent arrivals to the region as they are rarely found at undisturbed artesian springs. The high dispersal capability of both species is also supported by their wide distribution, that includes offshore islands and island states including New Zealand. *Venatrix arenaris* and *V. fontis* are both nocturnal species and are found mainly in the permanent wetland areas of the spring vent and tail, while the remaining species appear to be diurnal with some inhabitating the margins of the springs.

Artesian spring wolf spiders in South Australia, like many lycosids, are dependent on a constant supply of water. For example, some lycosids are exclusively found near rivers (e.g. Manderbach & Framenau 2001, Framenau et al. 2002), lakes (Greenstone 1983), or coastal shore lines (e.g. McKay 1974; Döbel et al. 1990; Morse 1997, 2002). Certain behavioral adaptations may facilitate colonization of habitats near water bodies, such as mobile brood care, the capability to walk on the surface of the water (e.g. Ehlers 1939), and the ability to use polarized light for orientation (Papi 1955; Papi & Tongiorgi 1963; Ortega-Escobar & Muñoz-Cuevas 1999). Most riparian species have been recorded to use water bodies as retreats when predators are present and they can stay under water for a considerable period of time by trapping air in the dense cover of setae surrounding their body (V.W. Framenau & T.B. Gotch pers. obs.). However, an intriguing aspect of the lycosids associated with artesian springs is how they colonize these tiny, isolated habitats in an otherwise inhospitable environment, given that several species are known to be extremely susceptible to even short periods of hot, dry conditions.

Short distance dispersal by ballooning within spring groups (i.e., where springs are separated by 50–1000 m) has been observed after monsoonal storms (T.B. Gotch pers. obs.), and dispersal may also occur during infrequent localized floods when spiders could float between springs. However, it is unknown how spiders move between more distant spring complexes (i.e., over 10's to of 100's km), as these species are unable to survive for more than a few hours away from free water during summer (T.B. Gotch pers. obs.). It is possible that long distance ballooning may occur after summer rainfall when climatic conditions are optimal for ballooning, and/or that waterborne spider movement occurs as a result of extensive regional flood events. However, these events occur very rarely in the case of regional floods, while the chance of successful long distance ballooning must be considered very small, given that springs represent tiny targets, and the prevailing wind directions are largely west to east. Current research assessing the genetic differences among artesian

spring lycosid populations along flood channels in comparison to more remote populations is aimed at testing indirectly whether one of these dispersal methods is more likely than the other.

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